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Electrical World

THE evolution of the light and power industry is tending in a direction to prove that in every respect the original Edison system possessed all fundamental requirements.

The Future Distribution System

By W. C. L. Eglin

THERE is probably not a firm in the country which knows what it costs to sell any one of its articles, unless it sells only one article, nor a firm which knows what it costs to sell to any one of its customers.

The Value of Wholesale Business

By O. D. Street

THE need for lightning arresters varies over a wide range with the variation in surge conditions and condition of the apparatus. The final criterion of lightning-arrester application is economic. The protection must pay for itself in savings to apparatus and service.

Autovalve Lightning Arresters

By A. L. Atherton

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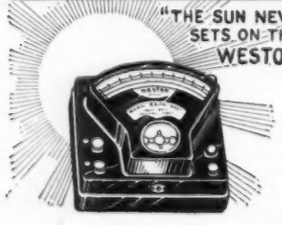

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Electrical World

The consolidation of Electrical World, Electrical Engineer and American Electrician

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W. H. ONKEN, JR. Editor — HAROLD V. BOZELL Editor

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Self-Development

THE creative thinking that is the great power behind all industry is done by but a few men. Upon these few men, therefore, rests the responsibility for the development and the progress of civilization.

The mental tests made by the government during the war in drafting forces for military service produced statistics that embraced 1,700,000 men — men who were taken from every stratum of society and were graded for intelligence. The average mental age of Americans was found to be about fourteen. Only 4½ per cent of our population rate above eighteen, and it is upon them that we must depend. From their ranks must come the superior minds who will carry onward the further advancement of the electrical industry for instance.

IT HAS been said of Abraham Lincoln, whose memory we have honored this week, that the very fundamental of his character was that he permitted himself to develop. Lincoln *permitted* himself to develop. And so he grew in knowledge, in confidence, in capacity, in influence and in usefulness to mankind. And out of the cabin on the frontier came through self-development one of that small group who do the thinking for the world, a great leader for all the people.

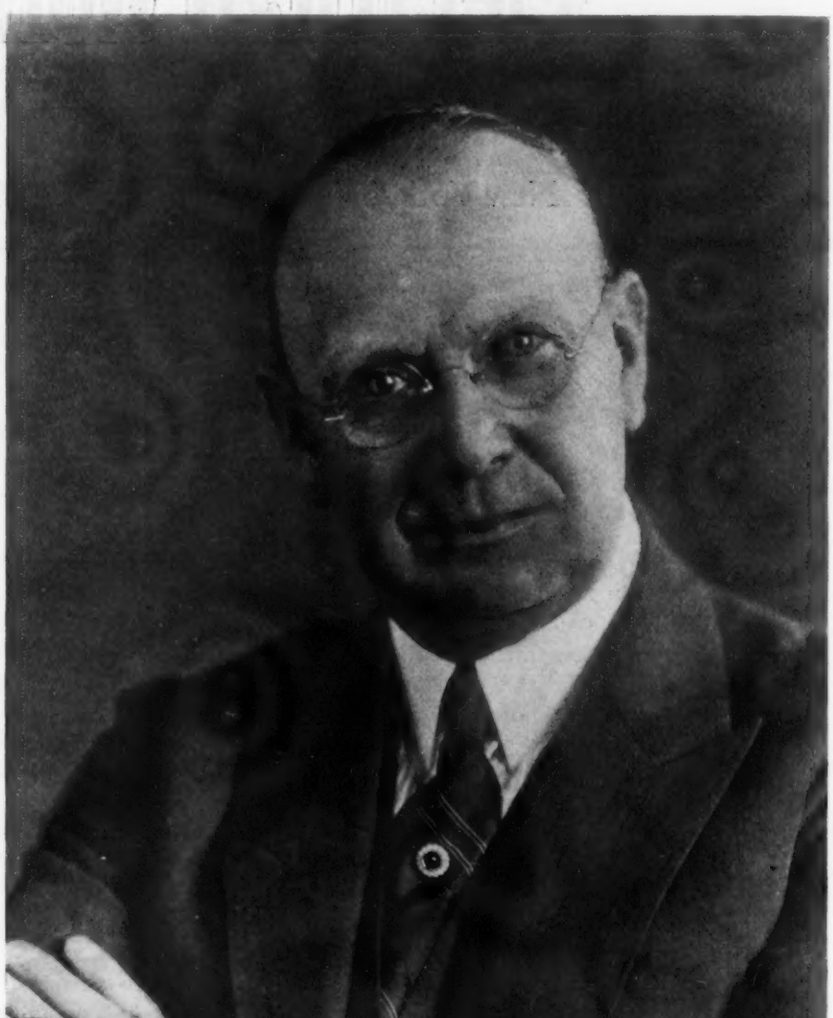
Opportunity and achievement do not come by inheritance. A man may enter life blessed with high mentality. He may have unusual advantages of environment and education. But his success in service, his value to society, will depend not alone on the extent of his ambition and his energy. It will be governed also by the degree to which he permits himself to develop and thereby take a higher place among his fellows.

THE greatest enemy of progress is the closed mind. The engineer, the manufacturer, the jobber or any one else who says, "This is my work," and will not learn and think beyond the day's need, is not only refusing to permit his own development, but is restricting his capacity for usefulness to the world that must depend upon his class for creative leadership. And the central-station executive who occupies his thoughts completely with operating, engineering and finance and does not build himself up for leadership in the community—he the head of a vital industry — is failing no less pitifully.

Men of the electrical industry are of that thinking class that carries the responsibility for progress — the small percentage of population that are blessed with superior minds. But the work that will carry civilization forward in the service of mankind will ever be done by individuals. The leaders will be those not born but self-developed to a superior usefulness. And, happily, development will come to any such man who will permit himself to grow.

James William Perry

A conservative leader among the electrical manufacturers, for twenty years an influence for constructive progress and good business practice.



IF ONE looks closely at the electrical industry, he will see a scattered body of enthusiastic men steadily pioneering through forty years in a new science, a new art, and building it into a new industry. These have been years of experiment in invention, in production and in the commercial fabrication of an organized business, and as ever there have been two contributing forces counterbalancing each other. They are the eager-hearted, visionary men who are impatient of restraint and ever seek to hurry on to new adventures and the prudent, sure and thorough-thinking men who keep their feet upon the ground, an influence for conservatism. In combination they evolve a structure that is sound to the core.

James W. Perry, general manager of the electrical department of the H. W. Johns-Manville Company, for twenty years has been a prominent figure among the leaders of the conservatives. A clear thinker, sound in judgment and firm in decision, he has stood midway between the radicals and the reactionaries and done yeoman service in the upbuilding of this industry through the most vital period of its organization and development on national lines. Mr. Perry has exerted a great influence for sound business methods in the electrical industry. He has preached the policy of live and let live, opposing price cutting and all destructive practices. His counsel has been courageous and optimistic. He was a prime mover in establishing the first organized co-operation among the manufacturers of electrical materials, which resulted in the forming of the Associated Manufacturers of Electrical Supplies. He was the treasurer of this association and a member of its board from its inception until last September.

Mr. Perry was born in Parkersburg, W. Va., in 1868. In 1889 he joined the Johns-Manville company's Philadelphia branch, where he continued until the consolidation of this company with the Mansville Covering Company of Milwaukee, in 1902, led to his transfer to New York in charge of the electrical business of the new company. He has continued the active head of the manufacture and sale of its electrical and automotive products and is a director in the company and in several subsidiaries.

Mr. Perry is treasurer and a director of the Electrical Manufacturers' Council, a director of the Electrical Manufacturers' Club, and has long been active in the work of the N. E. L. A., at one time serving for five years as chairman of its exhibition committee. He is a member of the A. I. E. E. and the American Electric Railway Association.

Editorial Comment

Electrical World, February 17, 1923

Volume 81 Number 7

Wanted— a Yardstick

MANAGERS of public utilities under a common control and executives of properties that have enough points of resemblance to make comparisons of operations instructive are becoming more and more interested in analyses of performance of all phases of utility operation and service, for thus they hope to better the service and earnings of their own companies. There are many unit data which are suggestive in making such comparisons, but the industry needs more light upon the possibilities of grading public utilities. Some of the well-known groups of utility operators have found the existing units of comparison wanting, and at present the field is open for suggestions as to improved methods of approaching this continuously important problem.

Selecting the Candidate for the Charles A. Coffin Medal

PRESIDENT FRANK W. SMITH has issued a letter to all electric light and power companies in the country indicating some of the factors which are to be considered in bestowing the Charles A. Coffin central-station medal. Readers will recall (see ELECTRICAL WORLD, Dec. 9, 1922, page 1293) that, according to the provisions establishing the Charles A. Coffin Foundation, "a gold medal . . . will be awarded annually to the public utility operating company within the United States which during the year has made the greatest contribution toward increasing the advantages of the use of electric light and power for the convenience and well being of the public and the benefit of the industry." It will be no small task to make the selection of this particular "public utility operating company," and there will doubtless be criticisms of the selection finally made. This much, however, should be said: that the annual bestowal of this medal will tend to bring into desirable prominence not only the utility receiving it but also and primarily the character of the service and the outstanding quality of this particular company. Thus others will be spurred on to adopt practices which are shown to be valuable and profitable—not for the mere winning of the next annual medal, but rather on account of the proved intrinsic worth of these practices. Of course, this is the principal value of all such medals, and the Charles A. Coffin medals and awards should, in the various lines in which they will be given, all serve to stimulate advance. It is proper and fitting that the name of Charles A. Coffin should be perpetuated in this manner as a constant reminder of his own contribution to the advance of electrical science and industry and as an encouragement to others.

It would also be a most fortunate circumstance if, in the work of the committees for the selection of the central-station company and for the selection of the electric railway company which are to receive the respective medals, some real contribution should be made toward the general question of rating of utilities for administrative or comparative purposes.

Röntgen's Contribution to Humanity

GREATNESS is sometimes measured by accomplishment, but he enjoys the widest fame who does most for his fellow man. Thus the discoveries of Prof. William Röntgen, who died last week at Munich, will cause his name to be remembered long after the details of his work have passed into oblivion. His contribution to humanity was the discovery of a particular type of radiation produced by the discharge of electricity through a vacuum, or Crookes' tube. These rays, called "X-rays" because at the time their exact nature was unknown, have the quality of penetrating substances opaque to ordinary light and of being absorbed by certain other substances which are transparent to light. When used in connection with the photographic plate, shadow pictures or radiographs of the bones of the body or of metal objects embedded in the flesh or in wood may be obtained.

Although from the point of view of the physicist valuable contributions to our knowledge of X-rays have been made by Prof. J. J. Thompson and the Braggs of Cambridge, England, and Dr. Lane of Zurich, it is the use of the X-ray in surgery, in therapeutics and in dentistry which has been of greatest interest and benefit to mankind. Unfortunately this knowledge was not obtained without sacrifice, and many are the martyrs who have suffered burns and destruction of the flesh or even lost their lives in their endeavors to make the therapeutic value of the X-ray available to their fellow-men.

To Röntgen homage was due. Societies all over the world were named after him, and medals, honors and prizes were awarded him. Unlike many other benefactors of the race, he lived to see a most wonderful development of his discovery and to enjoy the fruits of his labor. His death adds another name to the gradually increasing list of departed scientists whose labors have been of signal benefit to humanity.

Right-of-Way Purchases Related to Public Policy

"GET your right-of-way before any one knows what you are going to do" was the advice recently given an engineer who had a transmission-line project under consideration. The idea is the survival of a policy acted on by public utilities of various kinds in the early days, but it is one that has produced no small amount of trouble for and ill feeling toward these same utilities. It is doubtful whether there are any cases in which right-of-way for a transmission line has been

obtained where the property owners have been in doubt concerning the nature of the project after permission to cross the first piece of land has been secured. On the contrary, the air of deep mystery with which the old time right-of-way man surrounded his dealings usually resulted in suspicion and higher costs than an open policy would have caused. Moreover, right-of-way acquired in this manner is usually obtained with oral promises that are not written into agreements, and if they are violated, the ill feeling aroused lasts over long periods of years.

The purchase of easements or other rights for transmission-line right-of-way purposes by a power company ought to be a clean-cut business proposition in which the power company enjoys the confidence of those with whom it deals to such an extent that they, believing the advent of the power company to mean good to the whole community, will be willing to suffer some inconvenience, if necessary, in view of the greater good to come. In short, the power company in buying its right-of-way is conducting a legitimate business deal that is essential to the maintenance of its position. If the operation can be handled in this way, it can be made a means of better public relations. So long as it is handled in a secretive, hang-dog fashion there will always be unpleasant and unnecessary misunderstandings to live down.

Agricultural Engineers Called to Judge Central-Station Practice

THE appointment by the American Society of Agricultural Engineers at its St. Louis convention in December of a committee to deal with the problem of central-station service and utilization of electrical energy on the farm is a move the significance of which cannot be ignored. This society is the body in which the engineers from the agricultural schools and experiment stations meet to discuss mutual problems, and it has had for some time a committee dealing with the problems of service from the individual electric plant.

Back of the appointment of the committee lies a story of many demands from individual farmers for information on the use of electricity. Not only has this been the subject of discussion with the pioneers in the application of engineering principles to agriculture, but central-station practices and faults have also been under review. As might be expected, varying degrees of criticism of central-station policies have been expressed by the farm experts, and by virtue of their position the engineers in the agricultural schools and experiment stations have often been placed in the position of judges.

Several cases have come under observation in discussion with agricultural engineers in which there is serious misunderstanding of central-station conditions or in which central-station men who ought to know better have adopted arbitrary attitudes that provide just ground for criticism. The central station has a real story and a real problem in this situation. The agricultural engineers, many of them electrical engineers who have turned to the agricultural engineering field after graduation, are capable of investigating, appreciating and judging that story. By virtue of their position and the confidence reposed in them the farmer will look to them for advice and final determination as to the reliability of the representations of the central-station men.

From a central-station standpoint, therefore, there is only one outcome to the situation. It is that in every state central-station organizations should work with the agricultural engineering and experimental schools in the search for the right methods of bringing electricity to the farm.

Need of Simple Methods for Determining Conductor Sizes

TO THE man building up a distribution system the problem of the proper size of wire to use for extensions presents itself several times a day. In the past this problem was too often settled by the application of some set rule passed down from foreman to foreman, sometimes modified as conditions changed materially, but generally having its origin in some vague, general consideration of strength of material, of convenience in stock keeping or safe carrying capacity.

Nowadays it is hardly necessary to point out to the man laying extensions that economical consideration should be the basis in the selection of wire sizes. However, he must fail in his work unless he is given some convenient means of applying economies to such design. While each one of these may seem of quite small importance, the aggregate over a year's work is capable of showing economies involving thousands of dollars.

Any system should be able to work out constants which can be applied generally to its specific conditions. The result of these economical solutions, combined with the element of judgment necessary to determine on the number of sizes to be used, should show real economies in the distribution system.

Peterson Coil Not a Panacea

TO GROUND or not to ground is a question that has always created discussion. Now that several new types of equipment are available which enter more or less extensively into the solution of the grounding problem and about which extended operating experience is not yet available, the question is revived with more than usual interest.

One of the most prominent new absorption types of transmission-protection equipment is the Peterson earth reactance coil. This is coming into considerable use in some places. A general opinion exists that it is best adapted to low-voltage systems of limited extent, but field experience is needed to determine its limitations in application; and although it cannot be said to have received even a moderate indorsement for high-voltage systems, it has several features that offer possibilities for greater development.

The chief claim is that the coil suppresses an arcing ground through the agency of a local resonant circuit condition and that it decreases the possibilities of electromagnetic induction in neighboring circuits by eliminating the third harmonic. As against these advantages arguments have been advanced to the effect that the system insulation must still possess a high factor of safety as there is a tendency to produce voltage surges. Moreover, there are certain complications in making changes in the coil calibration as the system arrangements or conditions change, for it is very difficult to obtain sufficiently delicate adjustments to extinguish the arc for all conditions of frequency and wave front that may arise on a given circuit.

Variable-frequency transients, unbalanced grounds and resultant corona effects, and energy magnitudes of great variety—all these elements must be encountered by the resonant circuit adjustment. In addition, electrostatic effects still persist to produce disturbances in neighboring circuits, and the telephone engineers are unable to agree on the universal application of the Peterson coil to improve inductive co-ordination.

In the near future actual operating experiences with the coil should be available from several systems, and more definite conclusions can then be formed. It is a cause for congratulation, however, to see the co-operation of telephone and transmission engineers in the common problem of insuring the more satisfactory operation of transmission systems. In the long run what is best for the transmission systems is also best for the telephone system, and vice versa.

Penalizing the Electric Truck

THE lawmakers of this land do not yet appreciate that there is a difference between the electric vehicle and the gasoline car that should be reflected in the tribute which they pay toward the maintenance of the roads. The new motor-vehicle license law for 1923 in the State of New York, for example, is grossly unfair to both the electric truck and the electric pleasure car. The new tax is fixed on the basis of weight, with the result that a license for a five-ton (capacity) electric truck costs $104, as against $88 for the gasoline truck. The pleasure-car license figured on the same basis is even more unfair. The fee for 1923 is from three to seven times the fee for 1922, depending on the model of the car, that is, the year it was manufactured and its size. The unfairness of the new law is even more evident when the facts underlying its theory are analyzed. Two factors are assumed in shaping the law, one that the tax is in line with paying for wear and tear on the state highways and the other that such wear and tear is proportionate to weight. On both these counts the electric truck is unjustly rated. In the first place, its rapid development during the last three years has been for town and city local haulage and not for interurban and state highway use. In the second place, with any car the wear and tear on roads is not proportionate to weight alone, but is a product of weight and speed and the mechanical conditions of driving. Therefore, in spite of its greater gross weight per net ton carried, due, of course, to the weight of the storage battery, the "electric" is far easier on roads than any other type of truck. The simplest proof of this is that tires give a longer life on an electric truck than on a gasoline truck of the same capacity, and obviously the smooth starting torque of the electric drive and the absence of shock and vibration are the mechanical reasons for this longer tire life.

It is, of course, too late to abate the injustice of the New York law this year, but the issue is not confined to that state. Across the country it has become common practice to reckon license fees on the basis of car weight, and this method of estimating the road-destroying influence of a vehicle discriminates against the "electric" because of the natural characteristics of the car and the kind of service in which it is used. It has become important, therefore, that the manufacturers and users of electric vehicles take the initiative in devising some simple method of determining a license fee that will be fair to both electric and gasoline cars. They must then proceed to lay the facts before all legislative bodies with a constructive recommendation that will provide a fairer basis for taxation.

What Will Be the Future Ash-Handling System?

ACCORDING to opinions expressed at the recent convention of the American Society of Mechanical Engineers, the most desirable method of handling ashes is to use bottom-dump ash hoppers discharging into industrial or railroad cars. Such equipment is easily operated and maintained, does not require excessive headroom and is adapted to emergency ash-removal methods. When imperative, the ashes can even be dumped on the floor.

The importance of having hoppers of ample size cannot be overemphasized. No hopper should be so small that the corresponding furnace has to be shut down or operated at reduced rating because an accident to the ash-removal equipment has prevented dumping the hopper for several hours. Some companies are going so far as to provide three and even ten days' storage in their ash hoppers. But such large capacity is hardly feasible except with submerged ash pits such as the West Penn Power Company uses.

Submerged ash pits are said by their owners to require no more investment than any other types of ash pits. Besides they prevent emission of carbon monoxide, corrosive gases and flames.

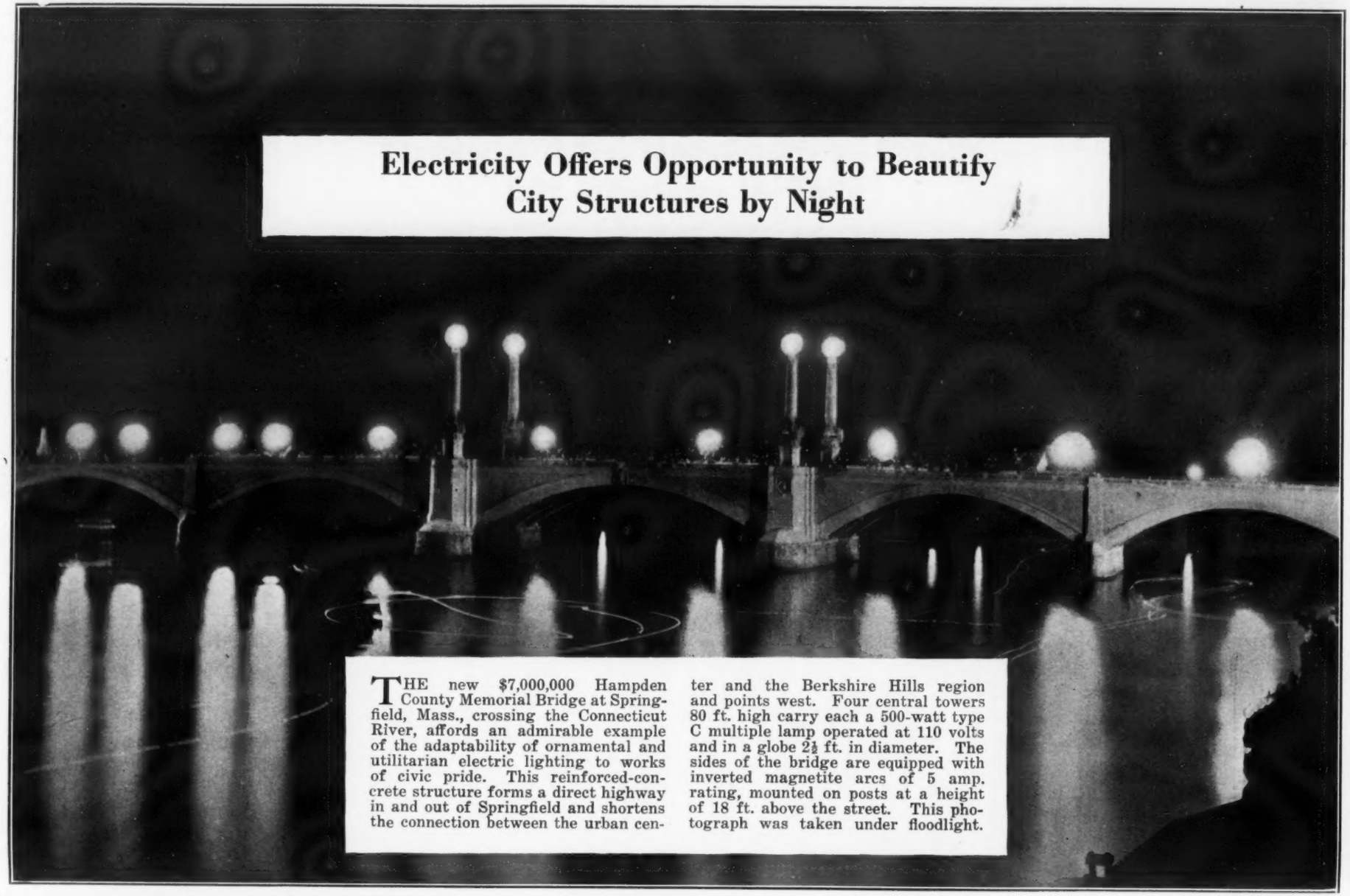
Mechanical conveyor systems will always find a place in plants which are so situated that the simpler form of ash-removal equipment favored at the A. S. M. E. meeting cannot be applied. When space requirements are limited they may be used to advantage, since the apparatus can sometimes be employed for both coal and ash. However, the maintenance expense continues to be a drawback.

Of late considerable attention has been directed to conveyors of the steam-jet and hydraulic-sluice type, apparently because of their simplicity and small space requirements. While they involve no moving mechanism to wear out, there is still the relative motion of abrasive ash and conduit. Furthermore, the steam economy of the jet type may be very poor unless the system is properly designed, the joints kept tight, worn nozzles replaced, and so forth. With proper attention given to the tightness of joints and provision made for readily replacing worn elbows, experience so far seems to indicate that ash containing fairly large clinkers can be handled. The Hell Gate installation of open-flume ash sluice is a noteworthy example of the hydraulic type which has operated very satisfactorily so far in the bulk supply station of the United Electric Light & Power Company.

With either form of fluid conveyor, however, it would seem desirable, in view of the limited experience with this equipment in the public utility field, to provide for some emergency method of ash removal in case the conduits should clog up or some similar contingency should occur.

Speaking generally, that ash system will be best which assures the highest reliability for the least annual expense (including fixed charges) and which can be readily supplemented by some expedient method in an emergency. How existing systems rank in desirability cannot be accurately determined until data like those mentioned above have been carefully compiled.

Electricity Offers Opportunity to Beautify City Structures by Night



THE new $7,000,000 Hampden County Memorial Bridge at Springfield, Mass., crossing the Connecticut River, affords an admirable example of the adaptability of ornamental and utilitarian electric lighting to works of civic pride. This reinforced-concrete structure forms a direct highway in and out of Springfield and shortens the connection between the urban center and the Berkshire Hills region and points west. Four central towers 80 ft. high carry each a 500-watt type C multiple lamp operated at 110 volts and in a globe 2½ ft. in diameter. The sides of the bridge are equipped with inverted magnetite arcs of 5 amp. rating, mounted on posts at a height of 18 ft. above the street. This photograph was taken under floodlight.

The Future Distribution System

An Analysis of All Types of Distribution Systems from All Standpoints Indicates that One Type of Distribution System Is Best—Comparison of Methods in Tabular Form

By WILLIAM C. L. EGLIN
Vice-President and Chief Engineer Philadelphia Electric Company

IT IS rather remarkable to find that the evolution of the light and power industry is tending in a direction to prove that in every respect the original Edison system possessed the fundamental requirements of engineering and economics which would be specified in an ideal system of today.

The Edison system fed all loads for which it was adapted from generating stations containing only one type of equipment, and it did this from a single type of distributing system. These two fundamental practices are granted to be ideals in modern systems, and the trend of development is in this direction; but investigation proves that action on these fundamental facts has been hampered by the existing installations, and only very haphazard analyses have been made of the possibilities for accomplishing the desired results more rapidly.

The distribution system of today comprises all the plant necessary for delivering energy from the generating station to the meter of the consumer. In the historical development of this phase of the electrical system several systems have been used, some of which have been discarded, but others still exist in their original form, and in many properties several types are found in operation.

For using both alternating current and direct current well-known systems are:

1. *Series System.*—This system requires a series connection for all equipment, utilizes constant current and requires a voltage that varies with number of energy devices connected.

2. *Two-Wire Parallel System.*—This system requires a parallel connection for all loads, utilizes a variable current and requires a constant voltage.

3. *Three-Wire System.*—This system is similar to the two-wire parallel system but allows double voltage.

4. *Feeder and Main System.*—This system requires constant voltage on the mains and a voltage on the feeder which depends upon the load.

In addition to these systems the multiple-wire polyphase alternating-current system is in great use. Three, four, five or more wires may be used in this system and many variations in connections are available.

Fundamentals in Choice of System

From the available distribution systems choice must be made to secure the best results for the operations of a light and power company. Both financial and operating considerations enter into the study, and in addition the bearing of the decision upon associated activities must be weighed. From an electrical industry standpoint the public, the manufacturers and other light and power companies are concerned in the decision.

The cost of money is a major item in energy production and distribution, and from this standpoint it is essential to secure maximum output from all plant equipment per dollar invested. This points toward the use of one type of generating equipment and a single distribution system in order to take advantage of diversity in loads and to obtain the high load factors possible through the use of interconnected generating stations carrying the diversified loads.

A service element with many ramifications affecting associated activities is the requirement that there should be some fixed standard or standards of voltage applied to energy utilizing devices. A safe maximum voltage at which accidental contact would not be injurious to life would be the logical standard. This would raise the permissible minimum voltage to perhaps 150, either alternating or direct current. Of course, a slight allowance for the effect of line drop would be advisable in connection with the fixing of a standard voltage, and these variations should be kept above the standard value. The use of the highest possible safe voltage would reduce costs to the consumer, because voltage is a direct element in fixing plant investment and in addition is influential in fixing the cost of many energy-utilizing devices. It would seem advisable at this time to give further consideration to the choice of a standard voltage.

Series System Should Be Discarded

The series system should be eliminated from the industry. Few utilization devices are applicable to the system, and it is almost exclusively used for street lighting, with a consequent load factor of about 50 per cent, no diversity factor and about 10 per cent actual utilization of the copper. It requires a duplication of substation equipment and an added expense in overhead or underground construction. The parallel system must be used to supply other loads, and the present state of the art indicates that the street-lighting load could be carried on the constant-potential system with only minor modifications in circuit and plant arrangements. The development and extensive use of the incandescent lamp and the use which is being made at the present time of the constant potential mains for street lighting even under the handicap of control by time switches, pilot wires or manually, shows that satisfactory operation has already been obtained. The development of a satisfactory remote control switch to be operated over the mains themselves is the sole remaining step and this seems to have been satisfactorily solved on an experimental basis at least.

Direct-Current System Has Limitations

The direct-current system meets all the requirements imposed by the various uses of the consumer and in certain favored locations where the generating stations

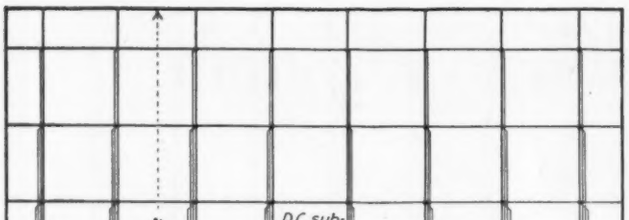


FIG. 1—BUSINESS DISTRICT SUPPLIED FROM ONE D.C. SUBSTATION

Peak load, 12,000 kw.; annual use, 46,000,000 kw.-hr.; load factor, 44 per cent; sixty-four feeders, average length 0.5 mile, maximum length 0.87 mile; weight of feeder copper, 560 tons; annual feeder loss, 6,400,000 kw.-hr. (14 per cent).

can be located at the load centers meets other economical conditions.

However, in the large systems the generating stations cannot be located at the load centers, and with the great increase in load density now found in congested districts the territory that can be served with economy by direct current has been steadily decreasing in area. The economic size of substation supplying the direct-current system is much smaller than is now common practice, and this method becomes more and more expensive as the load density increases.

To make concrete the limitations of the direct-current system assume that a business district including an area of one square mile and having a sustained peak load of 12,000 kw. is to be supplied with power at 230 volts. The annual consumption is estimated to be 46,000,000 kw.-hr., corresponding to a load factor of 44 per cent. The load density is assumed to be uniform, corresponding to 187 kw. supplied at each street intersection, there being eight blocks per mile. Three methods are compared:

1. An Edison direct-current system using one substation at the load center (Fig. 1).

2. The same using four substations each at the load center of its district (Fig. 2).

3. Three-phase, four-wire alternating-current system having a bank of transformers at each feeding point (the street intersections) supplied from a single substation at 2,300 volts. A complete network of 2,300-volt mains is assumed, thus making use of the maximum of copper (offset, of course, by the advantages of reliability and diversity). The power factor is assumed to be 83 per cent (Fig. 3).

Practically the same amount of copper is required in the low-tension mains in each case, and the losses in these mains would virtually be the same. The feeder copper and losses of the above paragraphs 1 and 2 are to be compared with the copper and losses in the 2,300-volt mains, feeders and transformers of paragraph 3, the comparison being as follows:

System	(1)	(2)	(3)
Current	D.C.	D.C.	A.C.
Substations	1	4	1
Number of feeders	64	64	10
Average length, miles	0.50	0.25	0.42
Maximum length	0.87	0.37	0.62
Weight of feeder copper, tons	560	280	94
Annual feeder loss in millions of kw.-hr.	6.4	3.2	1.6
Annual feeder loss, per cent	14.0	7.0	3.5

Figs. 1, 2 and 3 show the feeder and main systems of the various methods by means of single-line representa-

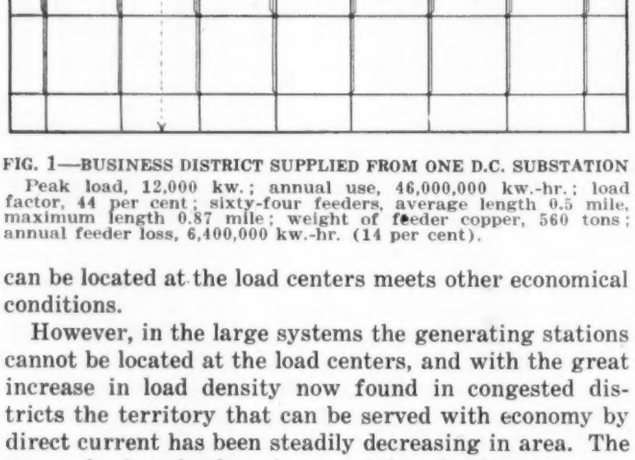


FIG. 2—BUSINESS DISTRICT SUPPLIED FROM FOUR D.C. SUBSTATIONS

Peak load, 12,000 kw.; annual use, 46,000,000 kw.-hr.; load factor, 44 per cent; sixty-four feeders, average length 0.25 mile, maximum length 0.37 mile; weight of feeder copper, 280 tons; annual feeder loss, 3,200,000 kw.-hr. (7 per cent).

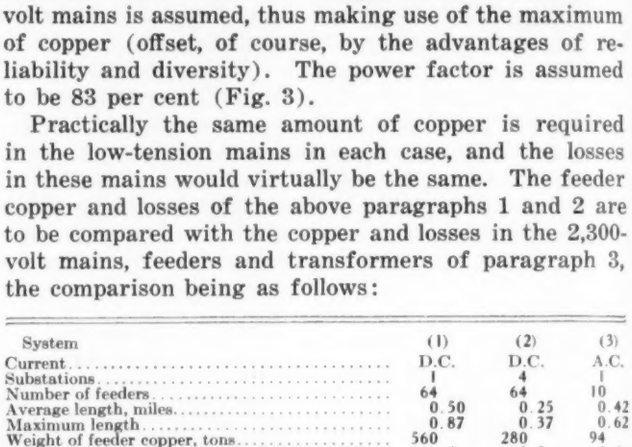


FIG. 3—BUSINESS DISTRICT SUPPLIED FROM ONE A.C. SUBSTATION

Peak load, 12,000 kw., at 83 per cent power factor; annual use, 46,000,000 kw.-hr.; load factor, 44 per cent; ten feeders, average length 0.42 mile, maximum length 0.62 mile; weight of copper in 2,300-volt feeders and mains, 94 tons; annual loss in transformers and 2,300-volt system, 1,600,000 kw.-hr. (3.5 per cent).

tion. The comparison of the figures shows the relative street congestion due to the various methods, and Fig. 4 gives a comparative idea of the relative weight of copper necessary in the different systems and compares the losses also.

The power companies have usually confined the direct-current system to the built-up, heavily loaded districts and have installed alternating-current distributing systems in all of the territory surrounding this built-up section, generally covering a much larger area. The load in this outside territory thus supplied by alternating current is generated usually at the same generating station and transmitted at high voltages to substations, where the voltage is stepped down to a secondary transmission system and connected through line or manhole transformers to the consumers' mains. Here we meet, however, with the greatest differences in methods and an almost complete lack of standardization. There are single-phase lines, two-phase lines, three-phase lines and four-phase lines made up of two-wire circuits, three-wire circuits, four-wire circuits and five-wire circuits. Surely one of these methods must be the most economical in first cost, and the determination and use of this line, as has been pointed out, is of the first importance to the power company.

Polyphase alternating-current supply may be adapted for all of the uses of direct current either directly or by using local motor-generators or rectifying equipment. Alternating-current service is or may be as satisfactory to the consumer as direct-current service, particularly as opportunity is afforded the large consumer to obtain his power at wholesale by assuming the burden of transformation or conversion if he so desires. This conclusion is further justified by the fact that many cities have large business districts containing all classes of consumers which are outside of the direct-current district (if there is one) and that all consumers are satisfactorily served.

The following cost figures are based on an analysis of an existing system comprising a direct-current series system, an Edison system and an alternating-current system consisting of a four-phase, five-wire secondary network supplied mainly by two-phase, three-wire primaries but partly by four-phase, five-wire primaries. Thirteen-thousand-volt, three-phase generation and transmission is used, from which some power is also sold direct.

Generating and substation costs have been found to be as follows per kilowatt: Generating stations, $140; arc substations, $100; direct-current substations, $70; alternating-current substations, $40.

These costs are based on completed station capacity and are the average for several stations built at various times, under varying conditions of prices and in localities with varying load conditions.

Using these station costs, adding the cost of transmission and distribution systems, including substations and distribution transformers, and making allowance for the added generating capacity, etc., necessary to supply the losses in the respective systems, the investment costs per kilowatt delivered at the substation bus and at the customers' services are:

	Point of Substation Bus	Delivery Customers' Service
Series system	$633	$666
Direct-current system	356	404
Low-tension alternating-current system	298	347

Similarly, the operating costs, including fuel, attendance and maintenance of both stations and lines but not including fixed charges on investment, based on the year 1920, were found to be in cents per kilowatt-hour:

	Point of Substation Bus	Delivery Customers Service
Series system	1.96	2.07
Direct-current system	1.57	1.78
Low-tension alternating-current system	1.28	1.49

These operating costs include the effects of the comparative efficiencies of the three kinds of substations. These over-all efficiences are approximately as follows, in percentage: Series substation, 74.8; direct-current substation, 81.4; alternating-current substation, 98.

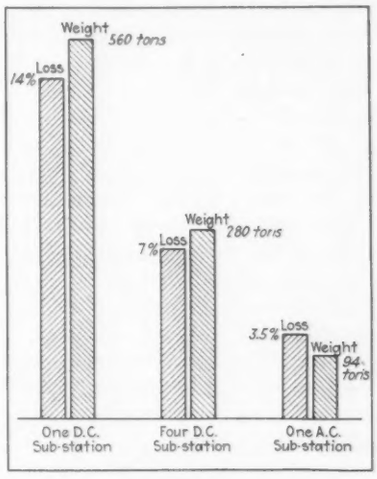


FIG. 4—COPPER WEIGHT AND ENERGY LOSS

Comparison of weight of copper and annual energy loss in various systems based on 500,000 circ.mil mains and 1,000,000 circ.mil d.c. feeders.

These figures show clearly that the low-tension alternating-current system is much cheaper both in first cost and in operation than the direct-current system, although the conditions of delivery into a densely loaded district favor the direct-current system. Moreover, the alternating-current system under consideration is not the particular alternating-current system which has been found by analysis to be the most economical.

The figures also show that the series lighting system is very expensive compared to either of the other systems.

The various methods which can reasonably be used for the primary distribution system are four—(1) two-phase using either three or four wires, (2) four-phase using five wires one of which is grounded and usually common to all other circuits of the same class of a par-

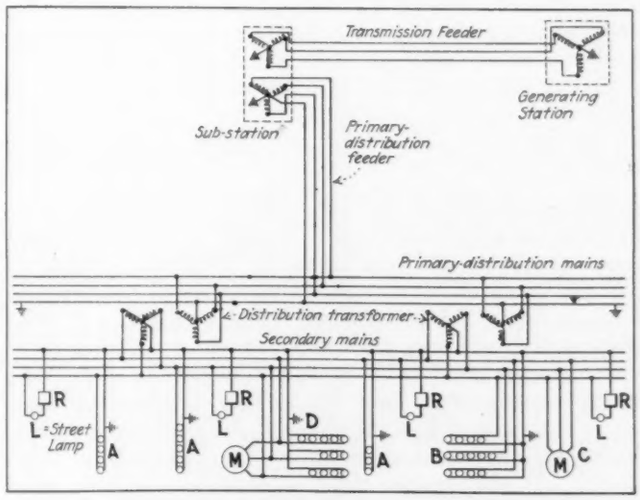


FIG. 5—UNIVERSAL ELECTRIC SYSTEM GIVES BEST AND MOST ECONOMICAL LAYOUT FROM DISTRIBUTION STANDPOINT

ticular pole or duct line, (3) three-phase using three wires, and (4) three-phase using four wires one of which is grounded and common as in (2). The relative economy of these various methods may be most clearly shown by a specific numerical comparison. The use of approximately 2,400 volts between phase wires is almost universal, and this voltage will be used as the basis of comparison. Assume that the line wires are No. 00, as many being used as are required by the particular system under discussion. The carrying capacity for such a wire strung on poles will be assumed to be 225 amp. and the drop with this current, 14½-in. spacing and 80 per cent power factor, is 156 volts per mile of wire. This drop would be increased slightly in some cases by the increased spacing due to poles, spacing between phases, etc. These results are compared in Table I and some further comparisons are made.

Two of these methods indicated by Table I—the four-phase, five-wire, and the three-phase, four-wire—are nearly on a par and stand out so much better than the others that one of them should unquestionably be adopted. The three-phase, four-wire method is simpler both in the substation, where one less bus is required, and on the line, where either four transformers are needed for each bank of the four-phase system or else the circuit must be split into two-phase circuits of the three-wire type, involving then some of the disadvantages of this method, which the comparison shows to be the worst of all. The question of safety is discussed later.

SECONDARY DISTRIBUTION SYSTEM

The ideal system for general distribution *at lighting voltage* must comply with several requirements: (a) It must be polyphase, so as to permit the operation of motors; (b) it must be a symmetrical polyphase system, so that the line drop due to a balanced load will not cause distortion of the voltages either in magnitude or phase, and the unbalance in voltage caused by unbalanced loads must be small; (c) the voltages available must be suitable for both light and power requirements and must not exceed a fairly safe maximum; (d) the energy delivered to both light and power loads must be capable of being measured by a single meter; (e) the investment cost per kilovolt-ampere delivered must be low; (f) the efficiency must be high; (g) the number of conductors must be as small as possible; (h) one conductor must be a neutral which can be grounded in such a way as to limit the voltage of all other conductors to ground to a value below 150 volts, and which preferably is symmetrical in voltage relations to the others; (i) this system must be capable of simple and economical derivation from the primary distribution system and this in turn from the transmission system.

TABLE I—STUDY OF PRIMARY SYSTEMS

System	1-a	1-b	2	3	4
Number of phases	2	2	4	3	3
Number of wires	4	3	5	3	4
Capacity per circuit, in kva.	1,080	765	2,160	933	1,620
Per cent drop per mile	13.0	9.2	6.5	11.2	6.5
Number of regulators	2	2	4	3	3
Circuit capacity per wire, in kva.	270	255	432	311	405
Per cent drop per mile per 1,000 kva.	12.0	12.0	3.0	12.0	4.0
Number of circuits per 10,000 kva.*	9	13	5	11	6
Number of wires per 10,000 kva.*	36	39	25	33	24
Number of regulators per 10,000 kva.*	18	26	20	33	18

* Nearest whole number.

The only polyphase methods which can be considered are: (1) Two-phase, three-wire, at 115 volts or 230 volts to neutral; (2) two-phase, four-wire, at 115 or 230 volts; (3) two-phase (strictly four-phase), five-wire, at 115 volts to neutral; (4) three-phase, three-wire, delta, at 115 or 230 volts per phase; (5) three-phase, four-wire, delta, at 230 volts, the fourth wire being a lighting neutral tapped from one phase; (6) three-phase, four-wire, star, 120 volts to neutral and 208 volts between wires.

Table II shows a comparison of each of these methods together with the three-wire system (using either direct current or single-phase alternating current) with respect to the requirements enumerated.

COMPARISON OF METHODS

Methods No. 1, No. 2 and No. 4 must be eliminated for the reason that they do not afford satisfactory voltages as well as for other reasons; method No. 5 is not a balanced system and cannot be metered on a single meter, and method No. 3 is needlessly complicated with its five wires, leaving method No. 6, the three-phase, four-wire star system, which seems to fill most satisfactorily all of the requirements and compares favorably with the direct-current three-wire method, the one drawback being its adaptation to the present normal voltages of lighting and power apparatus.

Since the same method was found to be most desirable for the primary distribution system, it seems evident that the general adoption of the three-phase, four-wire system is the only logical course. We will then have, following the present practice in generation, a 13,000-volt or 26,000-volt, three-phase, three-wire generation and transmission system with grounded neutral, a 2,400/4,150-volt, three-phase, four-wire primary distributing system with grounded neutral and a three-phase, four-wire secondary system with grounded neutral, operating at some voltages such as 120/208 to 130/225—the same system throughout. This system is shown in Fig. 5 complete from the generator to the various ultimate consuming devices.

SAFETY MUST BE CONSIDERED

In the direct-current low-voltage distributing system there is practically no danger to life. With alternating-current systems this is a serious hazard and must be considered of first importance in the design of any system; so that the safe maximum for the consumers' devices as it affects the life hazard should be determined.

Next in importance to the life hazard is the fire hazard. It has been proved that any system of distribution must be capable of having its neutral grounded so as to eliminate all fire hazard due to the accidental occurrence of grounds on different conductors. This is of equal importance in either direct-current or alternating-current systems.

Considering in detail the primary distribution system, each of the methods considered uses the same phase voltage. Some are operated normally grounded and others normally free from grounds. However, in times of trouble the normally ungrounded system may be grounded on any wire and wires may cross. The lineman who must clear the trouble may therefore be exposed to the maximum voltage possible because of any combination of grounds and crosses, and usually under circumstances of darkness, storm and excitement, such

TABLE II—COMPARISON OF METHODS

(a) Method	No. 1 Two-Phase, Three-Wire, 115 or 230 Volts	No. 2 Two-Phase, Four-Wire, 115 or 230 Volts	No. 3 Four-Phase, Five-Wire, 115 and 230 Volts	No. 4 Three-Phase, Three-Wire, 115 or 230 Volts	No. 5 Three-Phase, Four-Wire, Unsymmetrical	No. 6 Three-Phase, Four-Wire, Symmetrical	D. C. or Single-Phase, Three-Wire, 115 and 230 Volts
(b) Symmetry	N. G.	O. K.	O. K.	O. K.	N. G.	O. K.	O. K.
(c) Voltage	115 volts too low for power 230 volts too high for light	115 volts too low for power 230 volts too high for light	O. K.	115 volts too low for power 230 volts too high for light	O. K.	120 volts light, slightly high 208 volts power, slightly low	O. K.
(d) Metering	O. K.	O. K.	O. K.	O. K.	N. G.	O. K.	O. K.
(e) Relative investment	Equal area / Equal current density 115 volts—1.660 1.340 230 volts—0.830 0.670	115 volts—1.566 230 volts—0 783	0.978	115 volts—1.358 230 volts—0.679	0.904	1.000	1.174
(f) Relative losses	115 volts—1.476 1 784 230 volts—0.738 0.892	115 volts—2.090 230 volts—1.045	1.045	115 volts—1.808 230 volts—0.904	0.904	1.000	1.045
(g) No. of wires	3	4	5	3	4	4	3
(h) Grounding	O. K.	N. G.	O. K.	N. G.	N. G.	O. K.	O. K.
(i) Transformation	6.7% lost capacity	6.7% lost capacity	6.7% lost capacity	O. K.	O. K.	O. K.	Complex

Note.—Except as noted, the relative investments and losses are calculated on the basis of exactly equal current density in all conductors except the neutral which is equal in size to the other wires. These figures will be subject to modification to suit commercial wire size.

that the danger is even greater than that corresponding to the voltage.

Tabulating the conditions which exist or which may exist with the various methods, we have:

System	1-a Two-Phase, Four-Wire	1-b Two-Phase, Three-Wire	2 Four-Phase, Five-Wire	3 Three-Phase, Three-Wire	4 Three-Phase, Four-Wire
Normally grounded	No	No	Yes	No	Yes
Maximum possible voltage between wires	3,400	3,400	4,800	2,400	4,150
Maximum possible voltage to ground	3,400	3,400	2,400	2,400	2,400
Normal voltage to ground			2,400		2,400

The two-phase method using either three or four wires is very uncertain at times of trouble, and the voltage to ground may be larger than the normal phase voltage. The three-phase, three-wire method can introduce no voltage hazard higher than the phase voltage, but all three of these methods have the hazard due to unknown and uncertain conditions. Moreover, two fairly high resistance grounds or swinging grounds may exist on different wires which will not pass current sufficient to open the circuit breakers at the substation but will pass enough to burn off the wire in the resultant arc. In the case of either of the normally grounded systems no abnormal voltage conditions can exist and the accidental grounding of a phase wire is not so apt to arc and burn off the wire, since the first (the normal) ground has a positive, low-resistance path. While this may cause more frequent interruption, the damage is not apt to be so great nor the duration of the interruption so long.

The four-phase, five-wire method has the disadvantage compared with the three-phase, four-wire method that the maximum voltage between wires is considerably higher, which causes a greater hazard and will tend to increase the difficulty of maintaining insulation through tree exposures, and the larger number of wires increases this difficulty as well as the hazard.

The analysis given in this paper of the various polyphase methods of distribution, both for transmission and for distributing at primary and secondary voltages, proves conclusively that the three-phase, four-wire system best fulfills all the requirements as to reliability, safety, economy of pole and duct space, and low operating and maintenance costs; that it provides the largest capacity per dollar invested, and that it can be adapted, with suitable rules and regulations, to meet all of the conditions of central-station service, so that load of any character, not excepting street lighting, may be attached to a single distributing system, allowing it to enjoy all of the advantages of diversity factor, which is essential for the most economical operation of central-station service. This system may be extended into new territory as a single-phase system for light loads using a two-wire circuit, since it is capable of supplying domestic consumers and street lighting, with all the investment of permanent character, and may be supplemented later by the addition of two wires so as to take care of increased load as the territory is developed, enabling a common system to serve the entire area irrespective of the character of load, thus making for economy, simplicity and reliability.

In conclusion, such a system would eliminate many of the overhead wires which are now used and to which both the public and municipal authorities are constantly objecting, so that it would be possible, with substations suitably located, to distribute 20,000 kw. to 30,000 kw. from a single substation with pole lines requiring not more than two cross-arms, enabling the companies to continue distributing overhead over large territories at a lower investment cost than would be necessary in the event of underground distribution.

Developments of Electric Furnaces During 1922

DEVELOPMENTS during the past in the electric furnace for steel melting have not been lacking, according to views expressed by C. E. MacQuigg in a recent article in the *Iron Age*. New ideas on the induction furnace have been carried out. The position of the electric furnace in the steel industry has been de-

cisively stated by Dr. Mathews before the American Iron and Steel Institute, who is an acknowledged authority on the subject. Elimination of the crucible plant by the electric melting furnace seems about as remote as ever. From the tonnage standpoint, however, the electric furnace will naturally make a constantly larger percentage of the fine steels.

Regarded from one angle, the increased use of the electric heat-treating furnace has had to wait on educational propaganda. The reaction in the past toward a suggested installation for electric heat treating has usually been that the outlay would be prohibitive. Upsets in the relative cost of fuels have brought home the fact that the first cost alone and the fuel costs will not determine final economy per unit of product. While locality determines fuel cost, important factors must often be sought elsewhere in labor costs, quality of the work and ratio of the accepted to the rejected product. Among the considerations urged for electric treating are uniformity of operation, perfection of control, better furnace conditions, lack of danger of overheating the work and absence of gases and dirt.

Electrons from Hot Filaments

Thoriated Tungsten Gives 130,000 Times Electron Emission of Plain Tungsten — Other Materials Are Being Studied

WHEN metals are heated in high vacuum electrons, or atoms of negative electricity, evaporate from their surfaces. If there is another electrode in the evacuated space to which a positive charge is given the electrons drift over to this electrode (anode) so that a current flows between the two electrodes. Dushman has recently derived an equation which should supersede the well-known Richardson equation, giving the relation between the electron current and the temperature of the cathode. The advantage of this new equation is that there is only one constant which we need to know for each different cathode material.

The electron emissions from a large number of different materials have recently been measured. The thoriated tungsten cathode gives a current at a temperature of 1,500 deg. absolute which is about 130,000 times greater than that secured from ordinary tungsten. Some of the cathode materials have even much greater emissions.

In order to get all the current that a cathode is capable of giving, it is necessary to apply to the anode a high enough voltage to overcome what is know as the space charge effect. By putting gases inside the tubes positive ions are formed in the space between the electrodes by bombardment, and these neutralize the negative space charge and allow the current from the cathode to pass across the space with much lower anode voltages. In other words, the effect of gases is to increase the current-carrying capacity of the two. Such an effect is used in the Tungar rectifier. Care must be taken what gas is used, for many gases have the effect of cutting down the emission to a small value.

If very high voltages are used on the anode, so as to produce intense electric fields, it is possible to pull electrons out of the cathode. In fact, it is possible to pull electrons even out of cold cathodes—that is, cathodes at ordinary temperatures. The currents obtained in this way from the cathode come from very minute areas, but in these areas the current density amounts to more than 100,000,000 amp. per square inch.

The thoriated tungsten filament is a tungsten filament containing 1 per cent or 2 per cent of thorium, usually in the form of oxide. When such a filament is heated to about 3,500 deg. C. a little of the thorium oxide is changed into metallic thorium. In the meantime, however, any thorium on the surface of the filament evaporates, leaving only pure tungsten. If the filament temperature is then lowered to about 1,800 deg., the thorium gradually wanders or diffuses through the filament, and when it reaches the surface, if the vacuum is very perfect, remains there and gradually forms a layer of thorium atoms which never exceeds a single atom in thickness. The thickness of this film is therefore about one one-hundred-millionth of an inch, and yet this film increases the electron emission of the filament about 130,000 times.

Of course, this useful film is very sensitive and needs some protection to keep it in good condition. Very slight traces of water vapor or other gases would oxidize and destroy it. This can be avoided by putting in the bulb some substance that will combine with the water before this has a chance to attack the thorium film. Such a substance is metallic magnesium. Furthermore, it is necessary to avoid heating the filament to too high a temperature for otherwise the film might evaporate. It is therefore best to operate such filament within a rather narrow range of temperature close to 1,700 deg. C. where the ratio of evaporation is very small and where the temperature is high enough for the thorium gradually to diffuse to the surface and offset the effect of slight traces of residual gases.

The thoriated tungsten filament open up many new fields of scientific investigation. By measuring the electron currents it is possible to determine accurately exactly how much thorium is present on the surface. An amount of thorium corresponding to only one-thousandth of the surface covered with a layer one atom deep is easily measurable in this way. It is possible to knock off a thorium film by bombarding it with positive ions moving at high velocities, and in this way the true nature of this bombardment can be determined.

Controlling Electron Currents in High Vacuum

Most of the applications of high-vacuum tubes have depended upon the control of electron currents, as for example, by the grid in the three-electrode tube. The action of the grid is due to the charge on the grid modifying the space charge effect. This is the action that is employed in practically all tubes used today for radio transmission and receiving. There are many other methods, however, of controlling electron currents. A very important method is that used in the magnetron where there are only two electrodes in the evacuated space and the control is obtained by means of a magnetic field generated by an external coil of wire. A still simpler form of magnetron, suitable particularly to very large power tubes, consists of a very large filament in the axis of a cylindrical anode with very large, straight filaments. The magnetic field produced by the current through the filament is enough to prevent electrons flowing between cathode and anode.

Another form of tube by which electron currents can be controlled is the dynatron. This depends upon subjecting one of the three electrodes in the tube to electron bombardment in such a way as to cause electrons to be splashed out of it.

Performance Characteristics of Autovalve Lightning Arresters

Maintenance Reduction and Bettered Performance Are Claims for New Non-Chemical Protective Apparatus Suitable for All Applications—Principle and Basis of Design Described

By A. L. ATHERTON

Supply Engineering Department, Westinghouse Electric & Manufacturing Company

THE insulation of apparatus connected to any electrical system is subjected to surge voltages in some degree. Experience in the design of apparatus has led to the adoption of factors of safety which are sufficient to prevent apparatus failure under ordinary service conditions, but it has been found impossible or uneconomical to provide in this way for surge conditions. A benefit will be derived from the use of lightning arresters in all cases, but the need for lightning arresters varies over a wide range with the variation in surge conditions and condition of the apparatus.

The final criterion of lightning-arrester application is economic. The protection must pay for itself in savings to apparatus and service. The wide variety in service conditions, the difficulty in getting an accurate measure of arrester performance and the economic urge toward lower and lower costs has brought about the development of various protective devices covering a wide range in cost and in performance characteristics.

Judgment on any lightning-arrester problem, design, application or selection requires an understanding of the factors which make up both sides of the economic ledger account. On one side of this account is the saving which can be credited to the arrester—that is, the difference between the damage to apparatus and service which would result if the system were unprotected and the similar damage with the proposed arrester. On the other side of the account is the initial and maintenance cost. The damage to an unprotected system depends on local conditions, varies over a wide range and can be estimated only from experience and with engineering judgment. This factor is largely empirical and can ordinarily be determined only by experience on the system in question or on similar systems in similar localities. The damage to be expected with any particular type of arrester depends first on the local conditions which control the damage to an unprotected system and then on the characteristics of the proposed arrester. For an evaluation of this factor it is necessary to have a knowledge of the laws governing the phenomena of surges and of the principles of lightning arrester performance. These laws and principles are known with comparative accuracy. Initial and maintenance cost, on the other side of the ledger account, of course depend on the design of the arrester. For all commercial types they are fairly well known.

Characteristics of Surges

For the purpose of lightning-arrester considerations, a surge is a transient overvoltage resulting from the release in a system of a quantity of electrical energy which is free to flow in the circuit controlled only by the inductance, capacity and resistance of the circuit. The circuit has electrostatic capacity between conductors and to ground, and the conductors have inductance. The surge energy resides in the static field of the condensers and in the magnetic field of the inductances. When the energy is released on the line, as by the release of a bound charge following a cloud discharge or

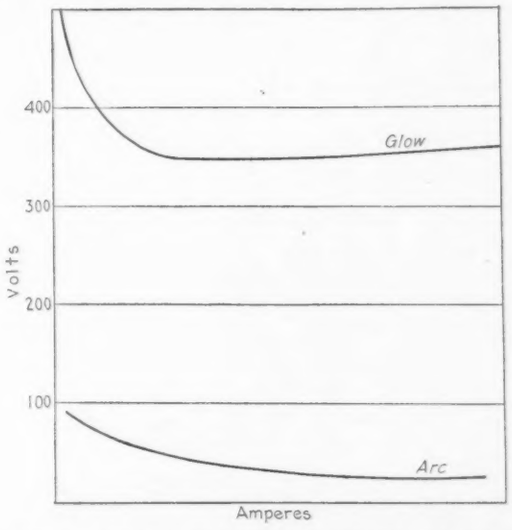


FIG. 1—VOLT-AMPERE CHARACTERISTICS OF ARC AND SLOW DISCHARGE

by the discharge of the magnetic field of apparatus in switching, a portion of the circuit is raised in potential above that of the adjacent circuit and current flows from the higher to the lower potential section through the distributed inductance of the conductors and charging the distributed capacity of the circuit into which it flows.

It has been shown that the relation of the current and voltage in surges is given by the equation

$$E = iZ = i\sqrt{L/C},$$

where

E = the surge voltage,
i = the surge current,
$Z = \sqrt{L/C}$ = the surge impedance,
L = the inductance per unit length of the line,
C = the capacity per unit length of the line.

This relation is of great value since it affords a means to a quantitative conception of the phenomena of the flow of surge current and makes possible the calculation of the division of current and the resulting voltages at branches in the circuit and at points where

the surge impedance is changed. For instance, it makes possible the calculation of the reduction in surge voltage resulting from the use of a lightning arrester of known characteristics.

It has also been shown that the propagation of a surge in a system is approximately at the speed of light; that is, 183,000 miles per second.

DANGER OF HIGH VOLTAGES AND STEEP WAVE FRONTS

The outstanding characteristics of surges are high voltages and steep wave fronts—the first because this is the major cause of the danger to insulation, and the second because it has considerable bearing on the characteristics which it is necessary to give to a lightning arrester for good performance. While definite data are not available as to the maximum surge voltage which may be impressed on a system, there are indications that surges of external or atmospheric origin may have voltages as high as several hundred thousand volts, and surges of internal origin due to switching may have values of several times the line voltage. The steepness of the wave front is also variable over a wide range. In the case of a surge which travels on the line for a considerable distance, the wave front may correspond to a frequency of less than 100,000, while in the case of a surge which originates at the apparatus, as by the release of a bound charge from a cloud directly over the point in question on the line, the wave front may virtually be infinitely steep.

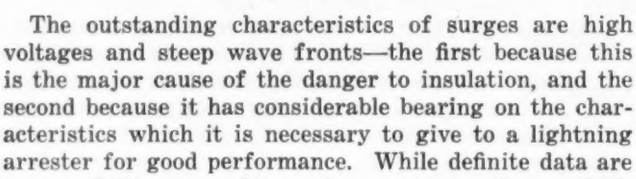


FIG. 2—BREAKDOWN VOLTAGE OF SMALL GAP IN AIR

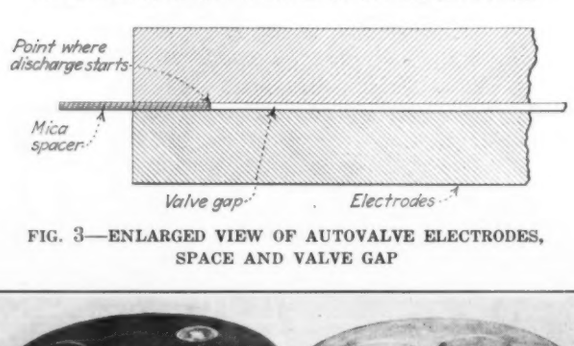


FIG. 3—ENLARGED VIEW OF AUTOVALVE ELECTRODES, SPACE AND VALVE GAP

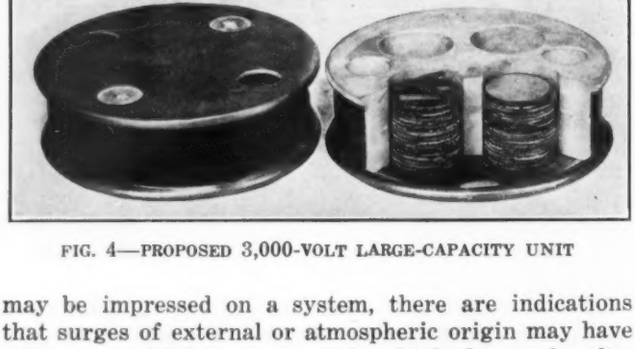


FIG. 4—PROPOSED 3,000-VOLT LARGE-CAPACITY UNIT

Very little is known quantitatively in regard to the effect of surge voltage on insulation. This is because the duration of these overvoltages is extremely short and the magnitude very great, which makes direct investigation difficult, and also because the chief attention of investigators of insulation problems has been given to study of performance under normal service conditions rather than under the abnormal conditions imposed by surges. It is probably a fact, however, that the damage which is done varies as some power of the voltage applied, possibly as the square, and that it varies directly with the time of application.

REQUIREMENTS FOR LIGHTNING-ARRESTER CHARACTERISTICS

A lightning arrester is a device which is inoperative under normal conditions, but which when a surge voltage appears should function to hold the surge voltage down to a value which will be safe for the insulation of the apparatus being protected. In order to do this, the requirements are:

1. The initial relief voltage, or the breakdown voltage, of the arrester must be at a safe value.
2. The discharge resistance, or the impedance of the arrester, to the flow of surge current must be low, so that the surge voltage will be reduced to a safe value. After the breakdown occurs the voltage across the arrester, and therefore across the apparatus being protected, is reduced from its original value in the ratio of arrester resistance to the sum of arrester resistance and surge impedance; that is:

$$E_1 = ER/(R+Z),$$

where

E_1 = the voltage on the arrester and apparatus,
E = the original surge voltage,
R = the arrester resistance,
Z = the surge impedance.

The value of a low resistance is made apparent by this relation.

3. The arrester must be always ready to perform.
4. The performance must be such that no system disturbances or other troubles are introduced by the operation.
5. Economic limitations must not be exceeded.

DISCUSSION OF TYPES

Efforts have continuously been exerted to develop a lightning arrester which would meet these requirements in the greatest possible degree, and these efforts have resulted in the development of the electrolytic arrester in its present form. This device is the standard lightning arrester for application where the maximum degree of protection is required. The first four of the requirements listed above are met by this device.

The breakdown voltage under surge conditions is only slightly higher than line voltage. This factor depends not only on the normal or 60-cycle breakdown, which naturally must be made higher than the line voltage, but also, because of the steep wave front of surges, it depends on the speed of breakdown, or, in other words, on the impulse ratio. The normal breakdown is made just enough above the maximum value of line voltage to prevent operation of the arrester due to line-voltage fluctuations. The speed is high—in fact, in the most highly developed form the impulse ratio is less than one; that is, the breakdown on steep wave front occurs at a voltage lower than the normal breakdown value.

The impedance to flow of surge current is extremely low. The only resistance is that of the electrolyte, the

circuit through which is very short and of large area. It is possible to make this type of arrester of such low resistance because no flow of power current is permitted. The characteristic of performance is such that practically no current flows at any voltage below a critical value and that at voltages greater than the critical value the current is proportional to the excess voltage. Thus when the normal conditions are restored the current is immediately reduced to zero and there is no "follow" of power current. Arresters without this "valve characteristic" cannot practicably be made with the very low resistance of the electrolytic, since they would pass large power currents, cause severe disturbances in the system, and since it would be impossible to provide for breaking the power arc in the series gap. With the valve characteristics these complications are all eliminated.

The third and fourth requirements are completely met. In some of the early forms of the electrolytic arrester trouble was experienced due to disturbances on the system set up by the charging operation, but the introduction of charging resistors eliminated this difficulty.

Unfortunately, however, the initial and maintenance cost are high enough to limit the application of electrolytic arresters to the protection of the more valuable or important apparatus. Moreover, the requirement for comparatively frequent attendance prevents their application in unattended installations.

Thus a large field of application cannot be taken care of by electrolytic arresters. Distribution transformers, ordinarily as much exposed to surges as any apparatus, for the most part do not economically warrant the use of arresters of such high cost, and it is practically never feasible to provide for the necessary frequent attendance. The growing use of unattended small substations and of the larger automatic substations introduces another large field where the use of electrolytic arresters is often not justified.

From the standpoint of service requirements, these applications require the same degree of protection as the larger attended equipments; but there has thus far been available no principle of operation which would provide the necessary valve type, or high-quality, arresters and at the same time be sufficiently flexible in design to meet the wide range of requirements of the various applications on the proper economic basis. There has been need for the development of a valve-type arrester based on a principle which is suited by flexibility to universal application and which will be of low initial cost, low maintenance expense, and will require, at the most, infrequent inspections. Such a device is provided in the autovalve arresters.

Principle and Design Basis of Autovalve Arresters

The autovalve lightning arrester is essentially a spark-gap type of arrester to which the practically essential valve characteristic has been imparted by proper design of gaps and electrodes. To have valve characteristics spark gaps must have a breakdown voltage equal to the voltage while the current is flowing. The voltage across an arc in air is as shown in Fig. 1, in the lower curve. When the electrodes are kept cool the discharge is no longer an arc, but becomes a glow discharge with volt-ampere characteristics, as shown in Fig. 1, the upper curve. The breakdown voltage of a gap in air is as shown in Fig. 2. Obviously, if gaps can be made which break down at the minimum point, 350 volts, and which maintain the discharge as a glow, the conditions for valve characteristics are fulfilled, for with such gaps current will start to flow at 350 volts per gap, will be proportional to the excess of voltage over this value and will cease flowing when the voltage is reduced to this value. Such gaps are used in the autovalve arresters.

The minimum breakdown voltage is secured by using electrodes separated by thin mica spacers, as shown in Fig. 3. With such gaps breakdown occurs at the edges of the spacers at a voltage far lower than would be required for the gap itself, as is well known. When the mica is made of the correct thickness, this breakdown voltage remains approximately at the minimum valve of 350. The discharge is maintained as a glow by the use of electrodes of moderately high resistivity. The high resistivity prevents concentration of the discharge and thus keeps the energy distributed over the surface of the disk, preventing local heating and thus preventing the formation of arcs.

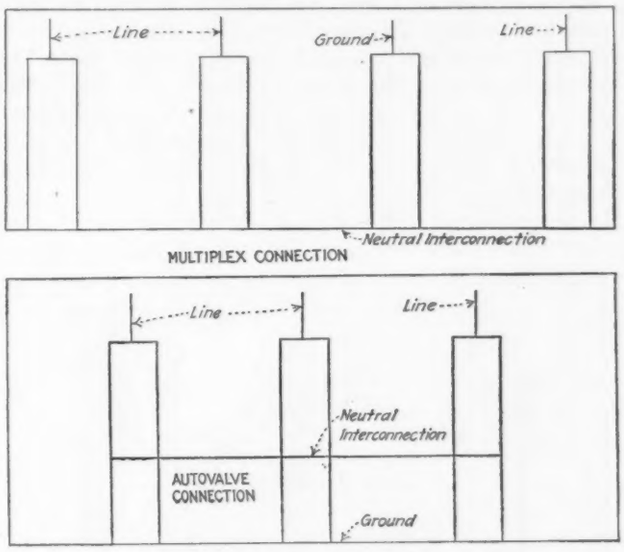


FIG. 5—AUTOVALVE AND MULTIPLEX CONNECTIONS FOR THREE-PHASE ARRESTERS

FIG. 6—PHASE LEG OF 37-KV., THREE-PHASE LARGE-CAPACITY ARRESTER

In the commercial form an autovalve arrester consists essentially of a column of disks and spacers forming a series of valve gaps, the number being proportioned to the line voltage and the area of the disk electrodes being such as to give the arrester the required resistance. Such a column in a proper casing is connected between line and ground through a series gap.

The number of valve gaps for any particular voltage is clearly indicated. In order to prevent the flow of power current, the line-voltage peak value must be less than the critical or counter voltage of the arrester—350 times the number of valve gaps.

The required resistance is not so clearly indicated because of the uncertainty in the maximum value of surge voltage which may be anticipated and because of the lack of complete information as to permissible surge voltages for standard or commercial insulation. In the design of these arresters, however, dependence has been placed on the years of experience with electrolytic arresters which have established that these arresters have performance characteristics which meet the service requirements. The area of the electrodes in the autovalve arrester has been selected to give a discharge resistance not greater than that of the standard electrolytic arrester.

Arresters of large capacity are made up of 3,000-volt units, each of which consists of four columns of

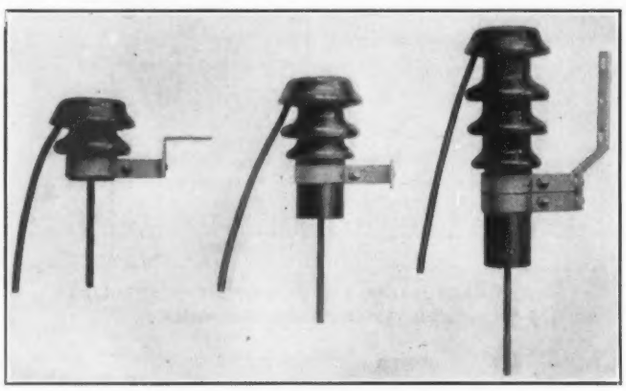


FIG. 7—DISTRIBUTION SIZES OF AUTOVALVE ARRESTERS

Three sizes of the line are shown with various forms of mounting bracket. The illustrated sizes are for 2,500, 7,500 and 15,000 volts.

disks 2 in. in diameter inclosed in a single porcelain case and held in place by metal ends spun over beads at the ends of the porcelain. These units are used in series to build up the phase legs of the large arresters for the protection of important apparatus in generating stations or substations. A single-phase leg of such an assembly for 37 kv. is shown in Fig. 6. In place of the familiar multiplex connection, using four columns each for phase voltage, three columns are used, each for line voltage. The two connections are schematically shown in Fig. 5. With the multiplex connection, the heavy surges of atmospheric origin pass through the three line elements in parallel and then all pass through the ground element. The voltage built up by the iR drop in the arrester resistance of the line and ground elements in series is thus four times that across a line element. With the autovalve connection this is reduced, since each element carries current from one line only. In the developed form there results a reduction of the equivalent resistance of the arrester to 43 per cent of that of the same arrester except with the multiplex connection.

Arresters such as are shown in Fig. 6 parallel the commercial forms of electrolytic arresters very closely in performance characteristics. The critical voltage or voltage maintained across the valve gaps while current is flowing is approximately 25 per cent above the peak value of maximum rated line voltage. This margin of 25 per cent is the only point of appreciable magnitude in which the performance characteristics differ. With the electrolytic arrester the critical voltage is determined by the voltage applied in charging and is equal to the peak value of the voltage thus applied. The 25 per cent margin of safety is justified, since it is relatively unimportant from the standpoint of protection and since it eliminates the possibility of the flow of power current due to extreme line-voltage fluctuations.

The initial relief voltage is only slightly higher than the critical voltage. As has been stated, the normal breakdown voltage is approximately 350 volts per gap and thus approximately equal to the critical voltage. The speed is very high, since the great time lag required for puncture of solid insulation is not present because the breakdown occurs in air only. The time lag is so small that only the most refined testing procedures have sufficed to measure it.

The discharge resistance is determined by the resistivity, thickness and area of the disks. The resistance is chosen to insure glow discharge and thus prevent the formation of arcs. The thickness is chosen for proper mechanical strength. With these two factors known, the area required to give a discharge resistance equal to that of the electrolytic is readily calculated and obtained. This disk area, with a factor of safety, is used.

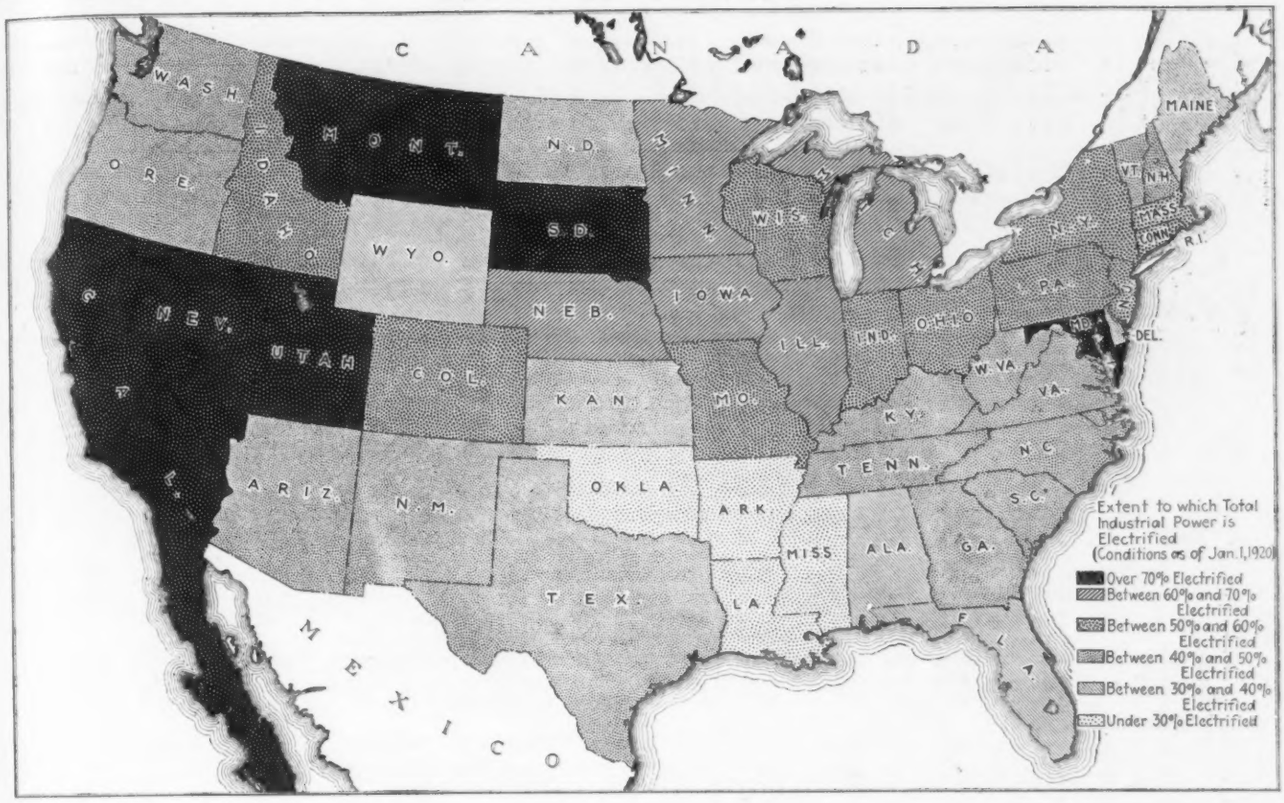
For use in applications where the expense of the large-capacity arresters is not justified, and particularly on distribution systems where arresters are installed close together so that more than one operates on any surge, a line of arresters of reduced area is provided. Three sizes, for 2,500, 7,500 and 15,000 volts, of this type "LV" line are shown in Fig. 7. In these arresters the design basis is the same as in the units of larger capacity except that a single column of disks is used. The performance is thus the same for the two types except that the discharge resistance is four times as great for the type "LV" as for the proposed large-capacity arrester.

Extensive laboratory tests over a period of two years and observation of more than 500 trial installations for periods ranging from nine to eighteen months have verified the theoretical basis both as to performance and as to durability.

The introduction of this principle of lightning-arrester construction marks a step of great importance in the control of apparatus failures due to surge voltages. Since valve-type arresters, suitable for use unattended and of any desired performance characteristics, can now be made within the economic limitations, it becomes feasible to provide adequate protection for apparatus of all classes and sizes under all conditions of installation.

Tests of Thermocouples

TESTS of the pure platinum and platinum-rhodium wire prepared at the Bureau of Standards for thermocouples have been carried out by the heat division. These tests are the same as those applied to commercial couples, which were recently reported by Fairchild & Schmidt in *Chemical and Metallurgical Engineering*. Results so far obtained are said to show that couples of material purified, melted and drawn to wire at the bureau are appreciably superior to the best commercial couples previously tested. Papers covering these subjects will be presented at the spring meeting of the American Electrochemical Society.



Rapid Growth of Industrial Load

Central-Station Motor-Connected Business Totaled 19,561,200 Hp. on Jan. 1, 1922—Pennsylvania Leads All Other States—Industry in the Aggregate About 61 per Cent Electrified at Present Time

THE growth of the central-station motor-connected load is one of the most remarkable facts pertaining to that industry of unusual achievements. Prior to 1907, only sixteen years ago, the lighting customers consumed more electrical energy than the industrial power customers, but since that date the total energy consumption by industrial consumers has increased by about 953 per cent, while the total energy consumed by the lighting customers has increased by only about 320 per cent. The electrical energy consumed by industrial power customers during 1922 was approximately 23,000,000,000 kw.-hr., while the lighting requirements probably did not exceed 8,000,000,000 kw.-hr.

The extent to which the motor-connected load has been cultivated by the central-station companies during the last eight years is clearly indicated by a survey recently completed by the ELECTRICAL WORLD. Returns received from about 70 per cent of the electric light and power industry indicate that subsequent to 1914 the connected motor load has almost tripled, totaling 19,561,200 hp. on Jan. 1, 1922. During this period the number of motors served has grown from 719,800 to 1,759,300, an increase of about 144 per cent. Details of this growth will be found in the tabulation on page 400.

A study of the data issued by the United States Census Bureau indicates that in 1920 there were 520,400 motors run by energy generated in private plants and that the rating of these motors totaled 8,228,800 hp. Adding these figures to those for central stations gives a total of about 2,300,000 electric motors installed on Jan. 1, 1922, with a total rating of about 28,000,000 hp. Further studies based on the census data indicate that in 1920 there was a total of 20,294,400 of industrial horsepower which had not been electrified, and that approximately 1,796,400 additional motors would be required to electrify fully all the industries of the country. A comparison of related figures indicates, therefore, that in 1920 the total industrial power of the country was only about 54.1 per cent electrified. It is estimated this figure has increased to about 61 per cent.

The central stations of the East North-Central States reported the largest motor-connected load on Jan. 1, 1922, with 5,251,300 hp. and a total of 530,900 motors. The Middle Atlantic States, another intensely industrial section, followed with 4,744,000 hp. and 429,300 motors. A study of the motors served by energy generated in private plants, however, indicates that the central stations in the Middle Atlantic States have a more fruitful field for increasing their motor-connected load through the gradual elimination of the private generating plants.

It appears that in 1920 California led all other states in the electrification of its industries. The reports indicate that 80.4 per cent of the industrial power of that state was electrified. Other states reporting a high percentage of industrial electrification are Utah with 76.8 per cent, Nevada with 72.2 per cent, Maryland with 70.5 per cent and Montana with 70.4 per cent.

Central-Station Motor-Connected Load and Degree of Electrification of Various States, 1915-1922

Division and State	Industrial Motors Served by Central Stations* (Thousands)								Motor-Connected Load of Central Stations* (Thousands)								Private Generation (1920) †		Unelectrified Industrial Power (1920)		Per Cent of Industrial Power Electrified (1920)
	1915	1916	1917	1918	1919	1920	1921	1922	1915	1916	1917	1918	1919	1920	1921	1922	Motors Served (Thousands)	Hp. of Motors Served (Thousands)	Horsepower (Thousands)	Equivalent (Thousands of motors)	
United States	719.8	817.8	922.3	1,066.5	1,212.0	1,413.0	1,607.8	1,759.3	7,345.3	8,657.2	10,015.4	11,762.2	13,551.0	15,672.0	17,974.8	19,561.2	520.4	8,228.8	20,294.4	1,796.4	54.1
SECTIONS																					
New England	81.8	91.1	100.9	116.9	130.9	159.6	181.8	195.6	688.6	764.6	882.4	1,046.3	1,184.3	1,420.7	1,621.8	1,783.5	68.5	796.9	2,201.1	231.7	50.2
Middle Atlantic	147.8	174.2	201.4	242.6	292.5	348.1	400.2	429.3	1,496.7	1,867.7	2,250.4	2,730.2	3,346.3	3,786.0	4,364.5	4,744.0	204.8	3,098.9	5,948.5	509.0	53.7
South Atlantic	51.8	56.9	64.5	75.8	88.4	104.5	118.9	125.7	548.2	848.1	790.7	984.2	1,219.5	1,493.1	1,656.8	1,723.0	28.9	648.3	2,098.9	143.7	50.6
East North Central	208.5	240.1	276.3	323.3	354.6	413.2	478.1	530.9	1,908.3	2,180.9	2,520.0	3,071.5	3,571.3	4,072.5	4,778.0	5,251.3	158.3	2,514.0	4,466.9	460.1	59.7
West North Central	67.5	73.5	81.0	91.8	101.2	116.3	128.6	136.9	542.9	634.2	744.6	845.7	926.1	1,043.2	1,080.1	1,138.0	24.7	380.1	1,106.8	119.8	56.3
East South Central	20.1	21.7	23.5	25.0	27.3	30.6	31.6	35.2	186.6	231.6	291.3	360.2	448.7	516.2	696.2	778.9	11.0	245.9	1,232.9	80.0	38.2
West South Central	19.5	22.5	25.2	29.2	33.4	37.9	39.8	43.0	148.3	180.8	226.9	287.4	344.8	498.7	587.2	614.8	7.2	146.7	1,474.5	117.5	30.4
Mountain	28.0	31.5	34.5	41.1	44.6	50.1	55.7	65.1	484.4	484.7	650.0	723.8	750.0	811.3	898.2	999.7	7.9	237.5	700.8	44.3	59.9
Pacific	94.8	106.3	115.0	120.8	139.1	152.7	173.1	197.6	1,341.3	1,464.6	1,659.1	1,712.9	1,760.0	2,030.3	2,292.0	2,528.0	9.1	160.5	1,064.0	90.3	67.3
NEW ENGLAND																					
Maine	6.6	6.8	6.4	6.9	7.4	8.2	9.3	10.0	82.3	84.8	87.4	101.3	107.2	116.2	132.8	145.9	3.3	72.0	413.2	28.2	31.3
New Hampshire	4.9	5.3	6.0	6.9	7.5	8.0	9.1	9.8	54.2	57.7	64.0	77.6	89.3	103.8	118.4	130.0	2.9	67.1	226.7	17.5	43.0
Vermont	6.7	6.7	7.1	7.7	7.9	8.5	9.0	9.4	64.2	73.8	79.6	87.8	88.2	96.2	106.0	106.4	0.9	13.0	124.4	11.0	46.8
Massachusetts	32.0	39.0	46.0	56.5	67.5	81.0	86.4	90.9	277.2	314.3	391.3	482.0	567.0	683.0	733.0	789.0	39.7	424.3	918.7	108.8	54.7
Rhode Island	9.0	9.7	10.9	12.5	13.2	14.9	17.0	18.3	57.3	63.0	69.6	80.6	90.6	120.5	137.6	151.2	7.7	65.9	184.0	22.8	50.3
Connecticut	22.6	23.6	24.5	26.4	27.4	39.0	51.0	57.2	153.4	171.0	190.5	217.0	242.0	301.0	394.0	461.0	14.0	154.6	334.1	43.4	57.8
MIDDLE ATLANTIC																					
New York	93.0	108.8	120.8	135.2	161.2	177.8	197.0	212.0	842.0	1,017.0	1,147.0	1,292.0	1,481.0	1,639.0	1,825.0	1,902.0	54.8	519.2	1,516.0	164.3	58.7
New Jersey	15.4	19.4	24.6	30.9	40.5	42.5	48.9	52.5	139.7	180.7	233.4	298.2	372.3	397.0	419.5	512.0	36.8	427.1	611.8	65.5	57.4
Pennsylvania	39.4	46.0	56.0	76.5	90.8	127.8	154.3	164.8	515.0	670.0	870.0	1,140.0	1,493.0	1,750.0	2,120.0	2,330.0	113.2	2,152.6	3,820.7	279.2	50.6
SOUTH ATLANTIC																					
Delaware	1.0	1.1	1.3	1.6	1.6	1.9	2.2	2.3	4.4	4.9	9.2	14.5	22.0	23.2	25.6	26.6	1.7	25.2	51.3	4.2	48.6
Maryland	5.9	6.9	7.9	12.7	17.4	23.0	26.5	29.1	77.8	87.9	99.2	161.2	223.4	297.0	332.0	357.4	5.4	162.7	168.2	13.2	70.5
District of Columbia	1.5	1.8	2.0	2.5	2.8	3.3	3.7	3.9	11.1	14.0	16.1	17.7	20.2	24.0	26.8	28.1	0.2	2.0	12.0	1.7	68.4
Virginia	6.5	7.5	9.5	11.8	13.4	16.6	18.2	18.9	44.8	63.7	90.2	118.8	164.2	179.0	196.7	210.0	4.0	85.8	277.0	25.7	48.9
West Virginia	7.2	7.7	8.7	9.7	13.9	15.4	17.5	18.5	132.4	167.4	211.5	243.5	270.0	337.7	377.8	384.2	8.0	187.4	639.1	29.2	45.1
North Carolina	12.6	13.6	15.3	16.6	17.3	19.6	22.3	23.6	98.0	107.2	131.3	154.2	196.2	237.4	262.8	273.5	5.5	63.7	318.9	26.3	48.5
South Carolina	6.9	7.2	7.8	8.1	8.4	9.3	10.6	11.2	79.5	89.8	103.0	120.6	141.0	167.7	185.7	193.0	1.3	36.8	238.4	13.2	46.1
Georgia	8.6	9.4	10.2	10.7	11.2	12.2	14.0	13.8	93.4	105.2	120.7	141.3	164.7	196.7	216.5	214.5	2.0	40.5	261.4	16.2	47.6
Florida	1.6	1.7	1.8	2.1	2.4	3.2	3.9	4.4	6.8	8.0	9.5	12.4	17.8	30.4	32.9	35.7	0.8	44.2	132.6	14.0	36.0
EAST NORTH CENTRAL																					
Ohio	82.2	91.6	102.0	113.2	118.7	131.8	159.3	170.3	508.0	560.0	622.0	834.0	996.0	1,227.1	1,488.0	1,636.0	47.8	860.1	1,696.5	181.8	55.2
Indiana	12.3	13.6	15.1	20.2	32.0	44.8	56.1	62.3	289.2	316.0	346.0	376.0	425.0	484.9	568.0	625.0	17.5	322.2	628.2	58.1	56.3
Illinois	61.2	71.4	83.5	100.4	108.0	125.3	158.8	177.8	665.0	792.5	910.0	1,079.0	1,200.0	1,305.0	1,528.0	1,692.0	46.7	681.5	924.1	88.7	68.2
Michigan	29.6	37.9	48.6	56.4	59.8	71.3	50.1	55.7	321.3	372.0	475.0	565.5	631.5	725.5	850.0	933.0	24.7	385.4	704.5	69.2	61.2
Wisconsin	23.2	25.6	27.1	33.1	36.1	40.0	53.8	64.8	124.8	140.4	167.0	217.0	318.8	330.0	344.0	365.3	21.6	264.8	513.6	62.3	53.7
WEST NORTH CENTRAL																					
Minnesota	19.3	19.6	20.0	24.0	24.4	29.1	32.2	36.7	244.2	267.0	290.7	326.0	343.0	370.0	383.0	436.0	5.2	100.7	360.0	28.3	61.7
Iowa	16.3	18.3	20.5	22.8	24.1	25.4	26.3	26.9	95.1	105.7	117.3	130.5	138.3	150.8	156.0	153.0	4.0	58.5	115.0	19.4	64.5
Missouri	16.7	18.4	21.7	24.0	27.0	30.2	36.1	37.2	122.7	135.7	164.7	184.8	213.5	248.4	264.3	256.3	10.1	122.9	305.2	37.1	54.8
North Dakota	0.9	1.0	1.1	1.3	1.4	1.7	1.9	2.0	4.9	5.2	5.4	6.0	6.4	6.9	7.1	7.3	0.1	1.4	11.6	4.7	41.7
South Dakota	2.3	2.6	2.6	3.1	3.5	4.3	4.8	4.9	15.8	16.9	17.6	19.7	21.2	22.9	23.7	24.4	0.4	12.8	14.0	2.6	71.9
Nebraska	6.0	6.8	7.5	7.8	10.7	14.4	15.4	16.3	24.8	28.3	49.1	57.4	74.5	100.2	100.3	112.0	2.0	26.6	65.0	9.3	66.1
Kansas	6.0	6.8	7.6	8.8	10.1	11.2	11.9	12.9	35.4	75.4	99.8	121.3	129.2	144.0	145.7	149.0	2.9	57.2	236.0	18.4	46.1
EAST SOUTH CENTRAL																					
Kentucky	4.2	4.7	5.2	5.6	7.3	8.9	9.0	10.0	24.1	39.2	64.0	80.8	97.7	125.6	216.8	252.0	4.4	91.4	237.0	16.8	47.8
Tennessee	7.8	8.3	9.0	9.5	9.7	10.5	11.0	12.0	81.5	90.7	101.5	110.0	114.2	138.9	140.2	158.2	2.6	45.7	252.4	19.1	42.3
Alabama	6.6	7.1	7.7	8.2	8.5	9.4	9.7	11.0	72.1	90.6	113.4	155.6	222.5	234.7	316.3	344.5	3.3	87.2	526.2	21.1	37.9
Mississippi	1.5	1.6	1.6	1.7	1.8	1.8	1.9	2.2	8.9	11.1	12.4	13.8	14.3	17.0	22.9	24.2	0.7	21.6	217.3	23.0	15.1
WEST SOUTH CENTRAL																					
Arkansas	2.1	2.3	2.5	2.7	2.9	3.1	3.2	3.5	21.9	24.7	28.0	25.4	28.1	35.1	42.7	46.3	0.8	17.3	195.9	17.3	21.1
Louisiana	1.5	2.0	3.0	3.2	3.7	4.5	5.3	7.1	15.8	20.8	30.8	37.2	44.3	68.3	74.5	83.0	2.0	43.5	363.0	23.9	23.6
Oklahoma	4.0	4.6	5.2	6.4	7.3	8.8	8.9	8.9	31.1	36.8	45.6	61.3	70.2	94.8	108.0	101.0	1.2	25.3	505.6	46.9	19.2
Texas	11.9	13.6	14.5	16.9	19.5	21.5	22.4	23.5	79.5	98.5	122.5	163.5	202.2	300.5	362.0	384.5	3.2	60.6	410.0	29.4	46.8
MOUNTAIN																					
Montana	7.3	9.4	11.2	13.0	13.6	14.5	15.8	18.0	162.3	204.5	211.5	231.5	237.5	256.0	280.0	317.0	0.4	11.0	112.3	6.4	70.4
Idaho	2.3	2.4	2.4	3.0	3.5	4.1	5.2	5.9	10.1	23.2	34.8	43.8	47.4	59.2	75.4	85.3	0.4	12.8	58.6	4.1	55.2
Wyoming	0.4	0.4	0.4	0.8	0.9	1.5	1.7	1.8	15.8	16.3	15.8	15.0	22.8	23.7	26.2	26.9	0.2	6.2	55.5	3.5	35.0
Colorado	7.4	7.7	8.1	8.8	9.7	10.2	10.4	11.1	78.8	0.8	129.3	155.6	157.4	158.6	168.4	189.0	2.2	41.2	170.7	11.0	53.9
New Mexico	0.5	0.8	0.9	1.1	1.1	1.3	2.0	2.2	8.6	9.1	9.6	10.1	10.1	9.9	11.9	13.2	1.4	26.7	52.9	7.0	40.8
Arizona	1.2	1.5	1.7	2.1	2.1	2.4	2.7	2.7	53.8	55.6	59.0	61.2	62.5	61.7	68.3	68.3	1.9	97.6	160.1	6.2	49.9
Utah	7.2	7.3	7.5	9.4	10.8	12.6	14.0	18.8	115.0	133.7	146.2	160.8	166.5	197.0	218.0	242.0	0.9	26.1	67.2	4.3	76.8
Nevada	1.7	2.0	2.3	2.9	2.9	3.5	3.9	4.6	40.0	41.5	43.8	45.8	45.8	45.2	50.0	58.0	0.5	15.9	23.5	1.8	72.2
PACIFIC																					
Washington	8.5	8.7	10.6	14.9	22.6	25.1	28.4	29.4	156.8	160.6	174.4	211.4	253.4	280.7	317.0	321.0	3.4	72.9	447.9	40.1	44.8
Oregon	2.9	4.3	7.2	9.5	10.2	11.1	12.7	14.0	32.5	57.0	23.7	103.2	107.6	115.0	122.0	134.0	1.3	26.1	197.2	20.4	40.4
California	83.8	93.3	96.7	97.5	105.8	116.5	132.0	154.2	1,152.0	1,247.0	1,411.0	1,410.3	1,404.0	1,642.0	1,860.0	2,085.0	4.4	61.5	418.9	29.8	80.4

* Based on U. S. Census of Manufactures.

Facts on the Value of Wholesale Business

The High Points of an Analysis of the Profitableness of Orders, Lines of Merchandise and Individual Customers, Based on the Experience of the Largest Electrical Jobber

By O. D. STREET

MANUFACTURING accounting is a highly developed art. This is because manufacturing accounting has received for the past half century an increasing amount of scientific attention. However, in the field of distribution, there is probably not a firm in the country which knows what it costs to sell any one of its articles, unless it sells only one article, nor a firm which knows what it is costing to sell to any one of its individual customers.

MR. STREET, who has recently become vice-president of the McGraw-Hill Company, was for ten years general manager of distribution of the Western Electric Company, in executive charge of its great system of fifty electrical supply jobbing houses. Through this period the business of these many branches has been analyzed and classified in deliberate, systematic effort to develop a sufficient volume of dependable statistics to make it possible to determine what has been the matter with the electrical jobbing business, by finding out what kind of orders, what kind of merchandise and what kind of customers are profitable and why. What these findings have been Mr. Street has briefly pictured in this article, which was presented as a paper before the Association of National Advertisers, just prior to his resignation.

Approximately ten years ago the Western Electric Company came to recognize how incomplete its knowledge was as to how it made even the little money which was then made in its jobbing business. We could not get away from the thought that there must be something, or several things, fundamentally unsound in our program—that there must be leaks somewhere, or that we were unconsciously pulling against some unseen resistance.

Analytical work was started. Clerks were put to work studying the cost copies for a period of twelve months on the number of orders received where the value was less than $5. Similar data were obtained at the same time on orders where the value was from $5 to $10, $10 to $25 and over $25. Table I is a summary of the results of such a study. These figures proved that we were losing money, and a pile of it, in connection with at least 60 per cent of our transactions—the small orders which carried the highest rate of profit.

A further analysis of the details of our expenses showed us that a great many of these expenses varied directly with the number of orders handled. A continuation of our studies along this line brought us to the point where we found we could closely approximate our costs in dollars and cents for handling the different size orders. Table II shows the result of one of these studies. This indicated that our expense on small orders—those where the value was less than $25—varied from $3.25 to $5, while the average gross profit on these orders averaged from $0.71 to $4.48. The average amount of loss on these orders was about $1.63, and as such orders represented about 60 per cent of all of our orders, the aggregate loss was found to be very large—close to three-quarters of a million dollars annually.

It is seen, therefore, that there were two major advantages derived from this particular line of investigation:

1. We discovered, contrary to our belief, that the orders which carried the highest rate of profit were in reality the ones on which, taken as a class, we were losing an enormous amount of money.

2. We discovered, again contrary to our belief, that the orders which carried the lowest rate of profit were in reality the ones on which, taken as a class, we made all our money.

PROFITABLENESS OF LINES OF MERCHANDISE

Having determined to our satisfaction the kind of orders on which we made money and the kind on which we lost money, we began to study lines of merchandise in order to see what we could learn in that direction.

Prior to the time of these studies and because we did not know of a more accurate method of approximating our costs, we, like other distributors, were accustomed to estimate the profitableness of our business by lines of merchandise by comparing the gross profit rate earned on each line with the average expense rate realized on the entire business. In computing the percentage of net profit earned on investment, consideration, of course, was given to a low investment, such as would result from consigned stock, direct shipments and prompt payments, but, in the main, the amount of net profit was determined by taking the difference between the gross profit rate on the line and our average expense rate and multiplying the sales of the line thereby.

But the studies above referred to had proved conclusively that such a method of computing costs was most misleading. We now know that just because our average expense rate is 15 per cent it does not follow

TABLE I—ANALYSIS OF ORDERS HANDLED

Value of Orders	Number of Orders	Per Cent of Total	Total Value	Per Cent of Total Value	Average Value per Order	Amount Gross Profit	Per Cent of Total Profit	Gross Profit Rate	Average Gross Profit per Order
Under $5	193,000	25	$463,200	1.0	$2.40	$137,030	1.6	30	$0.71
$5 to $10	108,000	14	783,000	1.7	7.25	223,560	2.6	29	2.07
$10 to $25	162,000	21	2,783,160	6.0	17.18	725,760	8.3	26	4.48
Total above classes	463,000	60	$4,029,360	8.7	$8.70	$1,086,350	12.5	27	$2.35
Over $25	309,000	40	42,577,800	91.3	137.80	7,630,200	87.5	18	24.70

TABLE II—RELATIVE PROFITABLENESS OF ORDERS HANDLED

Size of Order	Annual No. of Orders Handled	Average Value per Order	Average Gross Profit Rate, per Cent	Average Gross Profit per Order	Average Expense per Order	Average Net per Order	Total Net
Under $5.....	193,000	$2.40	30	$0.71	$3.25	—$2.54	—$490,220
$5 to $10.....	108,000	1.25	29	2.07	3.74	—1.67	—180,360
$10 to $25.....	162,000	17.18	26	4.48	5.00	—0.52	—84,240
Total above classes.....	463,000	$8.70	27	$2.35	$3.98	—$1.63	—$754,820
Over $25.....	309,000	37.80	18	24.70	14.58	10.12	3,124,500

that our expense rate on all our items, or on all our lines, or on all our orders, is 15 per cent. This 15 per cent is an average, and, being an average, it means that the expense rates on some orders are higher than 15 per cent and on some lower than 15 per cent.

By discovering and introducing this cost-per-order factor we had provided a gage whereby we could the more closely compute our costs on orders and on lines of merchandise. One of the more conspicuous instances where we changed our sales practice as a result of the application of this new method of computing costs was in connection with a certain line of merchandise on which we had always thought that we had made little if any money. Our average expense rate at this time was about 15 per cent, and in computing net profits on this line an estimated expense rate of 13.5 per cent was applied. As the gross profit rate that year on the line was 12.5 per cent, we figured that we had lost 1 per cent on sales and about 15 per cent on the investment. But in one of our studies we had found that the average value of our orders on this line was about $70, while the average value per order on all our business was at that time only $30 and the average expense per order was $4.50. This was before the war.

Since the average value of the orders on this line was $70, and since we had applied an expense rate of 13.5 per cent against the line, it was the same as saying that the cost per order for handling the line was $9.45 ($70 × 13.5 per cent) as compared with an average expense of but $4.50 per order on all our business. It must be remembered that our average order, the distributing cost on which was $4.50, contained two and one-half items, but here we were assessing $9.45 worth of expense against one item—more than twice as much money as it cost to handle the average two-and-a-half-item order.

After considering the expense from this angle, we concluded that our average expense of handling that line which was on consignment and on which we had no abnormal sales expense and did no advertising did not cost at the outside any more money per order than did our average order. Thereafter we applied 6.5 per cent as the expense rate applicable to our sales on this line, and since our gross profit rate has been averaging about 15 per cent on the item, we have been showing during the past few years a net profit of about 8.5 per cent on sales, instead of a loss, as had been our previous practice. Eight and one-half per cent net on sales indicates, as you can imagine, a handsome net return on the investment.

On still another line we had been showing a profit on sales of 15 per cent and a profit on investment of 38 per cent, but now on that same item, the gross profit rate being about the same as before, we are showing a loss on sales of about 2.5 per cent and a loss on investment of about 8 per cent. This was one of the items we had been pushing hard, because since the gross profit rate was 30 per cent we had thought we were making a great deal of money on it; but instead our new system of computing expenses proved that we were really losing money on every sale.

GROSS PROFIT NO GUIDE

In years gone by we, in common with other distributors, had been possessed with the idea that the only way to increase the net profit earned on our investment was to increase our rate of gross profit. Now we have come to see that there is vastly more money in some business taken at a low rate of gross profit than there is in other business taken at an appreciably higher rate. We see now that a gross profit rate means nothing until we know to what amount that rate is going to be applied.

As is seen by referring to Table III, since our average expense per order is about $7, we cannot make money if our orders average a value of $30, even if our gross profit rate be 20 per cent, for this would give us an average profit of but $6 per order. As our expense is $7, we should be losing $1 on every order. On the other hand, if the value of our average order is $45 and the average profit rate 18 per cent, resulting in a gross profit per order of $8.10, we shall make some

TABLE III—ANALYSIS OF TOTAL SALES BY MONTHS

	Net Sales	Gross Profits	Gross Profit Rate	Expenses	Net Profit	No. of Orders	Average Value per Order	Average Gross Profit per Order	Average Expense per Order	Average Net Profit per Order	Per Cent Earned on Investment
January.....			19.1			50,912	$46.85	$8.93	$7.65		
February.....			19.1			58,617	46.20	8.83	6.73		
March.....			19.7			63,042	46.75	9.21	6.55		
Average for the first quarter.....	$2,682,000	$518,000	19.3	$399,000	$119,000	57,524	$46.60	$9.01	$6.94	$2.07	14.2
April.....			17.9			60,383	48.95	8.77	6.93		
May.....			18.4			59,622	49.70	9.10	6.89		
June.....			18.4			60,756	51.45	9.49	6.71		
Average for the second quarter.....	$3,013,000	$550,000	18.2	$413,000	$137,000	60,254	$50.00	$9.13	$6.84	$2.29	19.7
July.....			17.1			62,620	54.38	9.30	6.94		
August.....			17.7			64,303	56.66	10.03	6.86		
September.....			17.1			65,424	60.54	10.40	6.96		
Average for the third quarter.....	$3,673,000	$635,000	17.3	$443,000	$192,000	64,116	$57.30	$9.92	$6.91	$3.01	26.9
October.....			17.0			76,992	62.00	10.50	6.90		
November.....			16.4			72,886	64.30	10.50	7.16		
December.....			16.4			92,302	66.83	10.95	7.67		
Average for the fourth quarter.....	$5,207,000	$862,000	16.6	$587,000	$275,000	80,727	$64.50	$10.68	$7.27	$3.41	33.8

money, and we shall make even more if the average value is $60 and the average profit rate 17 per cent, since that would give us an average gross profit per order of $10.20 against an average expense of $7.

Small orders, the more so where they are 60 per cent of all orders, tend to lower the average profit per order below $7. The large orders are the only ones which help to raise the average profit, and only by raising the average profit per order well above the average cost per order can we hope to make a good return on the investment. With us, under ordinary conditions of investment, the average amount of gross profit per order must be from $2.50 to $3 greater than the average cost per order in order to show a return of 25 per cent on the investment. This can be figured out by assuming a given condition where the average value per order is $56, the average profit rate is 18 per cent, the average amount of profit per order is $10, the average expense per order is $7, the average number of days receivable is 50 and the average investment in merchandise is $4.

Our formula would then work out as follows:

$$\frac{G-E}{M+R}=\frac{\$10.00-\$7.00}{\$\ 4.00+\$8.00}=\frac{\$\ 3.00}{\$12.00}=25 \text{ per cent.}$$

Cost per Order Constant

To comprehend thoroughly, you must see the line of reasoning followed in reaching the conclusion that our expenses per order tend to be relatively constant. Our expense per order is about 70 per cent higher than it was before the war, but the expense has gone up proportionately at all houses and most likely among all distributors. This increase is the result of the higher cost of labor, trucking, rent, etc. If these factors go higher, our average cost per order will be higher than at present. If they decrease, the average cost per order will decrease.

At our Salt Lake house, where the organization is small, the cost per order is $6, and only at one or two of our fifty houses, where certain known abnormal expenses prevail, have we a cost in excess of $7.50 per order.

With us the expense per order is relatively constant month by month at each house, month by month at all houses. This is because the expenses of such a distributing organization tend more closely to follow transactions than to follow sales value. This point is made more clear by the figures in Table IV.

You see that Chicago handles ten times as many orders as Salt Lake, and that the average value of the order at Chicago is twice as large; yet the average expense per order at Chicago is but $7.61 and only $1.61 more than the average expense at Salt Lake. If expenses followed values, and since the average value of Chicago's order is exactly twice as large as the average value of Salt Lake's order, Chicago's expense per order would be twice as large as at Salt Lake, or $12 instead of $7.61. For the past eight years the number of orders handled at each of the houses, and for the company as a whole, has not varied from one year to the next to any appreciable extent, and we do not expect that this condition will change. (See Table V.)

TABLE IV—DATA FOR CHICAGO AND SALT LAKE FOR TWELVE MONTHS

	Number Orders Handled	Average Value per Order	Average Expense per Order	Average Expense Rate
Chicago	131,000	$76.00	$7.61	10.0%
Salt Lake	13,000	38.00	6.00	15.5%
Per cent difference	+900	+100	+27	—35

While I have been emphasizing the fact that our average expense per order tends to be quite constant, I have not forgotten that we may still have too many employees at some of our houses and that the work of others is not as efficient as it might be. In other words, there is a chance at every point to do a more efficient, hence a cheaper, job. On the other hand, we recognize that with our office and warehouse work more or less standardized as it is, and with the competent department heads we have in charge at the houses, no great amount of money is being wasted. Our general department specialists are finding it harder each year to develop new methods by which we can reduce expenses. To be sure, a couple of men, after working a month last year at one house, were able to point out where changes could be made that would effect savings amounting to $4,000 per annum. Now, $4,000 is worth saving, but even if saved it will reduce the expense at that house only to the extent of 10 cents an order, since the house handles 40,000 orders a year. It is right that we keep our expenses down, and we expect to continue searching for better and cheaper methods, but we think that it is much easier by applying the knowledge we now have to get our average profit per order up 50 cents than it is to get our average expense per order down 10 cents. Not only is it easier, but it is nearly five times as valuable from a net profit standpoint.

Profitableness of Individual Customers

We have now considered how to test the profitableness of orders and the profitableness of lines, and how to watch the progress of the business as a whole; and there is one other thought which is worth considering. Let us see if by the use of these same methods we can get a better idea as to the profitableness of the individual customers, for, after all, it is the customer to whom we are trying to sell and whom we desire to serve.

Why is it that we have warehouses in fifty cities carrying in each several thousand items of merchandise? Why do we publish an expensive year book in which we indicate our ability to furnish no less than fifty thousand different items of merchandise? In short, for what purpose has this national sales organization of ours been created if not to seek out and serve customers in the expectation that the business relation thus established may prove profitable?

If it is the job of the distributor to endeavor to show a net profit on the business of each customer he serves, it is essential that we should have a gage whereby we

TABLE V—DATA OF NUMBER OF BILLS RENDERED

	1915	1916	1917	1918	1919	1920	1921	Aver. 7 Years
Pittsburgh	27,363	30,976	31,417	28,450	33,228	39,979	33,527	32,134
Atlanta	39,693	46,170	40,934	39,951	41,733	48,646	40,088	42,459
Minneapolis	37,763	41,262	37,115	33,213	35,741	47,418	41,486	39,143
St. Louis	34,614	41,180	36,845	34,952	39,584	43,596	35,258	38,004
San Francisco	38,255	39,598	36,652	34,092	38,604	47,144	45,110	39,922
Total all houses	700,459	800,653	752,605	705,407	788,572	913,835	757,922	774,208

can at least approximate the profitableness of a customer's account. A number of years ago we designed and sent to our houses a form to be used for this purpose, reproduced herewith in Table VI.

The very least we need to know is the annual sales, the average gross profit rate, the number of orders handled during the year and the average amount of profit per order. Above all, we must know the average amount of profit per order, for without those data we can tell nothing at all about an account from a net-profit standpoint. We may guess that it is good, but we are only guessing. An estimate based on fairly correct accounting principles is to be preferred.

Where we found that accounts were not being analyzed from a net-profit standpoint, some spot checks were made, along the line suggested by Table VI, and the results of some of these are cited below.

Monthly Analysis of Individual Customer's Account

	Sales	Gross Profit Rate	Amount Gross Profit	No. of Orders Handled	Average Value per Order	Average Profit per Order	Average No. Days Receivable
January							
February							
March							
Average first quarter							
April							
May							
June							
Average second quarter							
July							
August							
September							
Average third quarter							
October							
November							
December							
Average fourth quarter							
Average twelve months							

TABLE VI—FORM USED BY ALL BRANCHES IN ANALYZING CUSTOMER'S ACCOUNT

At one house we took an account of our sales, which were about $16,000 a year and the profit rate about 15 per cent. The sales manager expressed his belief that the account was profitable because, to use his argument, "the volume was large." After going to the books and counting the number of orders which had been rendered during the year, we found that the average profit per order produced by this sixteen-thousand-dollar account was $2.10. The average expense per order at that house was $6.50. The customer was being allowed 120 days in which to pay his bills, was receiving the benefit of our best prices, and the stores manager had stated that, from a service and claims standpoint, the customer was a "perfect pest," yet his unreasonable demands for special services were accorded, 120-day payments were allowed and best prices were quoted, because it was thought the account was profitable, and it was considered profitable simply "because the volume was large." When it was found that the average profit was but $2.10 per order, neither the sales manager nor any one else thought the account was profitable, and instantly steps were taken to change the situation, not by closing the account, but by changing the character of it.

At another house, where the average expense per order was $6.25, the two largest accounts on the books happened to be two central-station accounts. The purchases of one amounted to $60,000 that year at an 11 per cent rate of gross profit and those of the other to $58,000 at a 12 per cent rate. One was in the home city of the house and the other a hundred miles away. Asking the house concerned which was the more profitable account of the two, we were told that the one in the home city was the better. We counted the orders rendered during the year and found that the gross profit on the home city account averaged $6 per order and that on the other averaged $27 per order. You see, the management had guessed wrong, for there was no chance for a net profit in the home city account, while in all probability the other account, which produced $27 profit per order, was showing a return of better than 100 per cent on the investment. Bills in each case were being discounted and paid in ten days. It goes without saying that the home city account is now being studied so that it may be made a net profit earner as well as a volume builder, and the outside account is receiving more attention than ever before lest it should be lost. No house is going to take chances in losing so profitable an account after it once knows how profitable it is.

At another house, where the average expense per order was $7.50, several dealer accounts were analyzed. The volume in each case was large, the gross profit rate was good, and payments were prompt. The volume of sales and gross profit per order for twelve months on a few of these accounts are shown below:

	Total Sales	Gross Profit Rate	Average Value per Order	Average Profit per Order
Account No 1	$43,637	17%	$232	$39.44
Account No. 2	25,035	19%	169	32.11
Account No. 3	40,548	18%	157	28.26
Account No. 4	35,350	18%	121	21.78
Account No. 5	28,550	17%	170	28.90

Since we know there were no abnormal expenses in connection with the business of these accounts, we were satisfied that they were good money makers for the house. It is all right to watch sales volume, but we must not fool ourselves by assuming that a large volume of sales made to a customer necessarily means that we are deriving any net profit from the account. Such an assumption is not warranted without further analysis.

If, as is generally assumed, new alignments are to be worked out in the producing and distributing fields, and since it is a certainty that the successful agencies in both of these branches five or ten years hence will be those whose efficiency is of the highest, perhaps you will agree with me that those of us who would be recorded among the survivors must hasten to ascertain where we now stand, in order that losses incurred in unproductive endeavor may be eliminated and that the money thus saved may be invested in productive endeavor.

When we know the production and the distribution cost of each thing we market, when we know the profitableness of the account of each jobber we serve, and when the jobbers and wholesalers know the profitableness of the account of each retailer they deal with, then, and not until then, will there be fewer factories in which the same thing is made, fewer distributors who vend these articles in the wholesale mart and fewer dealers who pretend to serve the buying public. Then, and not until then, shall we have solved the question as to why production and distribution costs are so high.

Letters from Our Readers

A Place Set Apart for Suggestions, Comments and Criticisms, to Which All Men of the Electrical Industry Are Cordially Invited to Contribute

Value of Mathematical Studies in Engineering Education

To the Editors of the ELECTRICAL WORLD:

Current literature on electrical engineering subjects reveals a very marked and increasing interest on the part of prominent engineers in the education of engineering students. At a recent convention of the A.I.E.E. no less than five papers by leading engineers were devoted to this subject. The dominating idea of the discussion was the extreme importance of mathematics as the foundation upon which the superstructure of engineering must be built, it being even more important than physics and chemistry. The consensus of opinion also appeared to be that the majority of engineering graduates are very deficient in mathematics, especially in its application to engineering problems. To quote a very distinguished engineer on this subject: "Most of the graduates of the technical schools are woefully weak in mathematics."

The attention given by engineers to the teaching of mathematics in engineering colleges is intensely interesting in that it is obviously indicative of a change in the methods of handling engineering problems. It is one phase of the transition from the "cut-and-try" kind of engineering to what Mr. Lamme has so aptly termed "engineering by analysis" (B. G. Lamme, "Electrical Engineering Papers," page 755). The colleges are generally held responsible for the engineering graduate's lack of skill in applying mathematics to engineering problems, but are they altogether to blame for this condition?

Because of the prominence of the engineers who have voiced a demand for more thorough instruction in mathematics, it is readily inferred that this demand is a general one on the part of engineering executives. From the writer's experience he would judge, however, that this is far from being the case and that most executives still prefer to have their engineering problems solved by the "cut-and-try" method rather than by analysis. The main reason for this probably is that efforts put forth in experiments are more in evidence than when they are expended in analytical investigations.

In development of new apparatus many schemes will ordinarily be investigated and discarded before a really good one is discovered; that is, many investigations will of necessity lead to negative results. However, if the conclusions reached, even though unfavorable, have been arrived at through experiments, enough energy and enthusiasm has usually been displayed by the engineer to satisfy most executives. On the other hand, although the cost of obtaining the same negative results by analysis may be only a fraction of the cost of experiments, the executive is likely to conclude that the engineer has been doing nothing, unless he, himself, happens to have a clear grasp of the mathematical processes involved, which appears to be the exception rather than the rule.

An incident which came to the writer's attention about a year ago is a case in point. Monel metal was found to have the peculiar and interesting property of changing its magnetic reluctance at a temperature near the boiling point of water. It was discovered that a thin circular disk of this metal, mounted so as to rotate with little friction, could be made to revolve if one pole of a magnet was brought near the edge and heat applied to its surface a little distance from the point nearest the magnet pole.

Then, arguing from this fact, the brilliant idea was conceived of revolutionizing the design of energy-converting apparatus. At considerable expense a motor was constructed in which sections of the rotating element were to be alternately heated and cooled by air currents. An extremely simple calculation would show that the amount of energy which is required to make sufficient weight of the metal pass through the necessary temperature variations rapidly enough for even moderate speeds is so large that the efficiency of such a motor would approach the vanishing point. As reported to the writer, it did not even turn over when put on test.

Of course, this is an extreme case, and few executives would consider such a proposition seriously, but the point to be emphasized is that many of them as yet do not fully appreciate the value of "engineering by analysis." When the analytical side of engineering becomes recognized as a powerful tool of investigation and a general demand for engineers with more thorough knowledge of mathematics is created thereby, it is very probable that colleges will respond by turning out graduates better equipped to handle such problems than they are doing at present.

K. L. HANSEN.

Milwaukee, Wis.

Testing Polyphase-Type Watt-Hour Meters

To the Editors of the ELECTRICAL WORLD:

In reference to the letter of Prof. A. E. Knowlton published in the Jan. 13 issue of the ELECTRICAL WORLD (page 102) I would like to say that I appreciate criticism from such a high source and that this criticism is theoretically just. However, in connection with the practice of using resistance in the primary circuit of a phantom load in testing meters as described in an article on that subject in the Dec. 23 issue, I should like to say that there must have been some misunderstanding on the part of Professor Knowlton, or else the matter was not stated in a clear manner in the article.

In the plan outlined it might not have been clear that the resistance is not inserted in the primary to change the secondary current when differently sized meters are being tested, but only to compensate for the slight changes in the primary voltage due to fluctuations. The secondary current is regulated by the size of meter connected in the circuit and will automatically adjust itself to the required value due to the different and proportional resistances in the current coils of the variously sized meters, combined with that of the standard. In fact, this resistance in the primary is rarely ever changed, even when testing meters from 5 amp. to 50 amp., and consequently the power factor does not drop to an objectionable value and, by actual measurement, hardly ever below 90 per cent. Of course, this system is not recommended to calibrate rotating standards or to settle lawsuits.

DAN C. HOFFMANN.

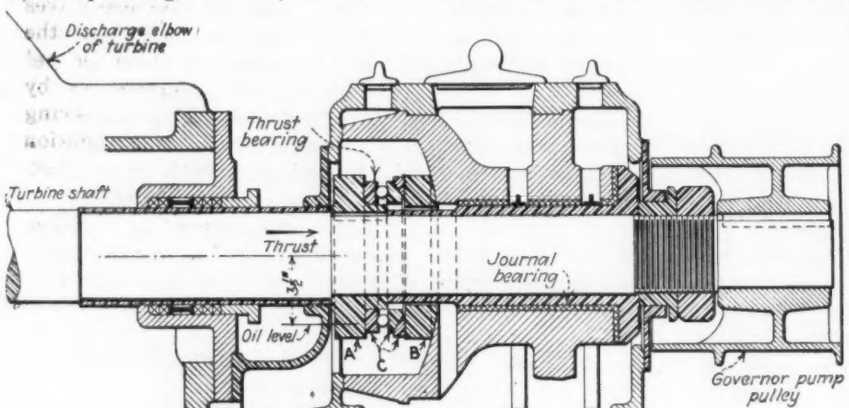
Austin Power & Light Company,
Austin, Tex.

Central Station and Industrial Practice

Installation, Operation, Maintenance, Test and Repair of Generation and Distribution Equipment, and Methods of Economically Utilizing Electric Service in Large Industrial Plants

Ball Thrust Bearing Solves Trouble Given by Disk-Type Bearing

TROUBLE with a disk thrust bearing led to the substitution of a ball thrust bearing by the Portland Railway, Light & Power Company. The former type of bearing had proved unsatisfactory in connection with the reconstruction of a 6,000-hp. single-runner, horizontal hydraulic turbine. Early in 1922 the company decided to reconstruct this turbine for a capacity of 8,200 hp., having been assured by the manufacturer that with a modern design of runner, new wicket gates and a larger discharge quarter-turn and draft tube this additional capacity could be gained at an improvement in efficiency of from 5 to 7 per cent.



ADAPTING BALL THRUST BEARING TO SINGLE-RUNNER, HORIZONTAL HYDRAULIC TURBINE SOLVES DIFFICULT BEARING PROBLEM

The change in quarter-turn necessitated a new thrust bearing to take care of the unbalance due to there being but a single runner. As soon as the new equipment was installed and the waterwheel put into operation trouble developed immediately in the thrust bearing. The new bearing furnished for the reconstructed wheel was of a modern design, consisting of one rotating and one stationary disk with babbitted face and self-aligning seat. Six weeks' time was spent in refinishing and making adjustments of the disk bearing, with the result that at the end of that time no reason could be found for the bearing not functioning as intended. The waterwheel unit was needed very badly for peak-load purposes, and no suggestions or recommendations were offered by the manufacturer to solve the difficulty. Urgent need of the unit demanded positive action. The disk bearing was laid aside and attention turned to other types of thrust bearings. A ball thrust bearing was found in local stock, and decision was made to try it as a solution of the trouble. With slight modification, parts were machined for adapting the ball thrust bearing, and the unit was placed in operation. The parts for adapting the ball thrust bearing were made, and the bearing was installed and operating within two days after it was decided to make a trial of it. The machine has since been in operation for nearly three months at from partial to full load with no trouble whatever. The total thrust on the bearing varies from about 6,000 lb. at no load on the unit to zero at about three-quarters load, beyond which point the thrust is practically neutral.

The accompanying illustration shows in cross-section the general arrangement of the thrust bearing. The parts furnished locally to adapt the ball thrust bearing are indicated by *A* and *B*. It will be seen that part *B* has a spherical self-aligning seat. The ball thrust bearing, which also has a self-aligning washer, is indicated by parts marked *C* between *A* and *B*.

E. D. SEARING,
Construction Engineer.
Portland Railway, Light & Power Company, Portland, Ore.

Running Cables on Racks Sometimes Dangerous

IN BUILDINGS where there are a number of heavy wires or cables it has been the custom to carry these cables on racks. This arrangement is really an adaptation, used indoors, of the plan, used outdoors, of carrying the wires open on arms on the poles. Outside, the carrying of very heavy feeder lines on the poles is more and more being done away with and cables in underground ducts are taking the place of the former open wiring.

In many stations the cables are now carried in ducts, but in many others, even among those recently constructed, the old plan of open wiring has been followed. This open wiring is without doubt cheaper and permits of making alterations to the wires more easily. Another advantage claimed by some for supporting the cables on racks is that space is saved, although such a saving, if it amounts to crowding, may be a disadvantage.

While the saving of space in stations such as those noted in the article on page 1452 of the Dec. 30 issue of the ELECTRICAL WORLD is always desirable, when it can be done without resulting disadvantages, and is sometimes necessary, yet open wiring is not a good way to save space as its very compactness militates against its use. In case of trouble on one of the cables, particularly one of the lower cables, there is great danger of the arc, or flame

from burning insulation, spreading to adjacent cables and the trouble increasing until many, if not all, of them are involved.

If the cables are run in conduit as far as possible inside of the station, there is little likelihood of the trouble spreading from one cable to another, because, even if they are nearly as close together as they would be if run on racks, they will be separated by the fireproof and arc-proof walls of the ducts.

By running the wires in conduits inside of stations a fire hazard both to the cables themselves and to the building is done away with.

Westfield, N. J. G. H. MCKELWAY.

Extracts from Operating Code

BY FIELD EDITOR ELECTRICAL WORLD
New York, N. Y.

Instructions for Starting Turbo-Generators

BEFORE starting turbo-generators it is important to see that the slip rings are clean, that the brushes are properly adjusted to them and that the brush rigging is tight, in order that there may be no resistance to the flow of current on account of faulty conditions at these parts. The field resistance is all cut in at starting to prevent the possibility of dangerous voltage as the speed of the machine approaches normal value.

The primary object of an air washer when used with a generator is to cleanse the cooling air for the generator, thus preventing the clogging of the air ducts and the deposition of dust on the windings. Besides reducing the heat-transferring ability of the windings, dust deposits and oil form adhesive coatings which it is difficult or impossible to remove. Where they are not entirely removed the oil attacks the insulation and shortens its life. From clean windings or iron, on the other hand, oil can easily be wiped. A secondary effect of the air washer is the raising of the humidity of the air nearly to saturation, since moist air has a higher specific heat than dry air and consequently will take away more heat from the generator windings with the same rise in temperature.

Following are the instructions for starting turbo-generators which have been specified by the operating code of the Philadelphia Electric Company:

TURBO-GENERATOR STARTING

1. Signal the engineer "slow."
2. After receiving a return signal from the engineer and allowing sufficient time for the turbine to warm up, signal "speed." The time to warm up depends upon how long the machine has been out of operation and upon its size. If the machine is cold, the time allowance should be at least one minute for each 1,000 kw. capacity.
3. When a bracketed exciter is used for excitation, close the exciter circuit breaker.
4. Energize the field, having the field resistance all cut in.
5. Start the air-washer pump and make sure that spray is being produced properly.
6. On receiving the signal "Load" from the engineer, answer it and proceed to synchronize and parallel the generator with the bus to which it is to be connected. Synchronizing methods will be given in later issues.
7. Load the generator at approximately 1,000 kw. per minute.

Putting Boiler on the Line from Banked Condition

FREELY blowing the superheater before the boiler is put on the line prevents any accumulated water from passing into the steam mains. The plates of the clinker crusher pit are protected from injurious heat by covering them with ashes winged back from the grate. Where dump plates are installed they are dropped to start the run with a clean fire.

The definite procedure for putting a boiler on the line from a banked condition as outlined in the operating code of the Philadelphia Electric Company is given below:

PLACING BOILER IN SERVICE

1. Blow down the water-column gage glass; test the gages by opening the gage cocks and see that there is not over 1½ in. of water in the gage glass when putting a boiler on the line.
2. Open the superheated drains wide and allow them to remain open until damper and stoker adjustments have been made.
3. Wing the ashes back on the clinker crusher, or drop the dump plates.
4. Close the dump plates.
5. Put the long stroke on the lower ram, in cases where hand-dump plates are used.
6. Shut off the draft on the extension grate.
7. Proceed according to rules 2 to 13, inclusive, published in the Feb. 3 issue of the ELECTRICAL WORLD, page 282, under the title "Detailed Instructions for Boiler-Room Force."

Points to Consider in Locating Meters

IN CHOOSING a meter location it is essential that the instrument be placed where its maximum accurate registering life can be obtained. Locations subject to vibration, dampness, dust and mechanical injury are to be avoided as far as possible. While the life and accuracy of the meter should receive first thought, its proper location as to convenience in reading, inspecting and testing must not be neglected.

Formerly many meters were wrongly installed, irrespective of the inconvenience caused the electric company, in order to comply with the desire of the customer to get the meter out of the way or to permit the contractor to save a little money on the wiring job. This leniency has resulted in meters being placed on porches exposed to weather, on stairways, in bathrooms, bedrooms, closets, coal piles, attics, over windows and doors and in many other inconvenient places varying in height from the floor level to 15 ft. above the floor.

Poor location of meters not only reduces the number read in a day, but at the same time causes undue annoyance to the customer and is the cause of most errors in reading, or even of guesswork on the part of the meter reader, who dislikes to take the time and trouble to see the dial clearly. Mistakes in meter reading are embarrassing to the company; often time and expense are necessary in rectifying them, and possibly the good will of the customer is lost. Wrongly placed meters also increase the cost of testing.

The aim of every company should be to see that its meters are installed in the proper location. The cellar is usually the logical place. Merely to place the meter in the cellar is not enough, however. It should be easily accessible, not less than 4½ ft. nor more than 6 ft. above the floor, and as near the service entrance as possible at a point where no obstruction is likely to be erected. If the cellar cannot be used, the next best place should be chosen. Where the building is under construction a fireproof cabinet for the meters can often be placed in the wall at an accessible place.

The best method is for the electric company to require the contractor to make application for a meter location on a form furnished by the company before any wiring has been

192

LEDGER NUMBER	CUSTOMER	CLASS OF POWER	JAN. 1ST.–MAY 1ST.						MAY 1ST.–SEPT. 1ST.						SEPT. 1ST.–DEC. 31ST.						ARTIFICIAL TEST					
			DATE	K. W.	℄ REG. FOUND	℄ REG. LEFT	Remarks	BY	DATE	K. W.	℄ REG. FOUND	℄ REG. LEFT	Remarks	BY	DATE	K. W.	℄ REG. FOUND	℄ REG. LEFT	Remarks	BY	DATE					BY

FIG. 1—LEDGER RECORD OF METER CONDITIONS ON DIFFERENT INSTALLATIONS

done. The company then sends an inspector to determine the location, records the exact spot designated for the meter on the form sent in by the contractor, and either notifies the contractor orally of the desired location or sends him a duplicate of the form he filled out. It is often convenient for the service location to be designated at the same time. The form filled in by the company's inspector is turned over to the service and meter departments to serve as a check when the meter is finally installed.

W. C. DEVIN,
Meter Department.
Chester Valley Electric Company,
Coatesville, Pa.

Test of Relay and Circuit Breaker Mechanism

TESTING of relays may indicate whether they will operate satisfactorily in service, but it gives no assurance that the control circuit is intact or that the circuit-breaker mechanism will function as desired. Still, all of these parts must perform their duties jointly or the best relay will be useless. Hence a power company in the Southern States makes a practice of testing the combined relay, current transformers, control circuit and breaker-operating mechanism regularly with a portable transformer connected between the two disconnecting switches on each side of each circuit breaker, so as to include these components.

The testing transformer has a 110-volt primary and a low-voltage secondary with several taps, thus permitting full, double or triple-rated current to pass through any circuit breaker. The transformer was made from an old 2-kw. machine, only the original iron core being used. The windings were adjusted until the desired current values were obtained.

In making the tests a cycle counter is used to determine the time required between application of the test current and the completed opening of the circuit.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Meter Test Record

WHEN meters are tested on the customer's premises the conditions found and the adjustments made are too often left unrecorded, notwithstanding that the information may be of considerable value at a later date in meeting a customer's complaint, determining the necessary frequency of test or for another reason. With the inspection and test sheet reproduced herewith one large Southern company has been enabled to discuss intelligently any meter readings with its customers, and has besides been able to check its meter-test men and keep a record which is very helpful in establishing the required frequency of tests as well as the need or otherwise of changing meters. Though the information required may seem unduly elaborate, it

INSPECTION AND TEST SHEET Leg. No._____

METER DEPARTMENT

DATE	TIME STARTED		COMPLETED		DIFF.	
CUSTOMER						
LOCATION			WHY TESTED			
AMP.	VOLTS	MAKE	TYPE	DK.	K	
SER. NO.	CO. NO.		READING START			
Answer in Affirmative with Check Mark—Negative, Cross			FINISH			
Are circuits going to meter O. K.?			DIFFERENCE		Checked O. K.	
Condition of Meter, Transformers, and Connections, O. K.						
Stop-watch reading ⎓ s.	K. W.	H. P.,	⎓ s.	K. W.	H. P.	
Mill Instruments reading	Ind. Wm.		Ammeter			
Is normal load on?	If not, how much load.					
Do light and heavy sides of Meter and Test-meter run O. K.?						

SERVICE TEST WITHOUT OPENING METER

LOAD IN K. W.	% FULL LOAD	REVOLUTIONS TEST-METER	REVOLUTIONS METER	% REGISTRATION FOUND	% REGISTRATION LEFT	ADJUSTMENTS AND REMARKS
						Change, if out of calibration over one per cent.
						If Meter out over 2% and seems in bad condition, make artificial test.
ARTIFICIAL TEST						
						Was Meter opened?
						Did you clean off around Meter and cover?
						Are Magnets and Disc clean?
						Are Jewels, Shaft, and Pivots O. K.?
						Are Gears meshed, hands tight, and in correct position?
						Are Magnets and Adjustments tight?
						Does Meter creep on shunts only?
FINAL SERVICE TEST						

Are all Screws and Adjustments O. K.?			Are all Connections tight and O. K.?				
Check stop-watch reading ⎓ s.		K. W.		H. P.			
If less than before test, why?							
Have you filled out all above at time of test? If not, why?							
Test Meter No.		Tested by		Check by			
Entered on Cards							
Found	Test-block	Sealed	Unsealed	Left	Test-block	Sealed	Unsealed
Found	Meter	Sealed	Unsealed	Left	Sealed	Unsealed	Why?

FIG. 2—METER INSPECTION AND TEST RECORD

has been found that even an occasional use of the records has justified recording all the data listed.

In addition to this record a ledger of condensed data is kept, like that shown in Fig. 1, which enables a quick historical study of meter conditions on any customer's installation.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Relay Nomenclature of the Electric Power Club

RELAY nomenclature as in the following list has been recently adopted as recommended practice by the Electric Power Club. The complete list is to be inserted in the next edition of the club's handbook of electrical apparatus standards under the heading of "Nomenclature." The definitions of the various types of relays and qualifying terms should assist materially in furthering clarity in specifications:

CLASSIFICATIONS OF RELAYS BY FUNCTIONS

General. — Where relays operate in response to changes in more than one condition, all functions should be mentioned.

Electric Protective Relay.—An electric protective relay is an intermediate device, equipped with contacts to open or close an auxiliary circuit, by means of which one circuit is indirectly controlled by a change in conditions in the same or other circuits.

Overload Relay.—An over-current relay in the circuit of a motor is one which functions at a predetermined value of the current to cause the disconnection of the motor from the line.

Directional Relay.—A directional relay is one which functions in conformance with direction of power, or voltage, or current, or phase rotation, etc.

Power-Directional Relay.—A power-directional relay is one which functions in conformance with direction of power.

Note.—This includes both unidirectional relays with single-throw contacts and duodirectional relays with double-throw contacts. The reason this name is preferred to "reverse power" is that the device is frequently used to function under normal direction of power. Furthermore, in some cases the normal condition of the system may permit power to flow in either direction. Relays for use in either alternating-current or direct-current circuits are to be classed as power-directional relays.

Polarity-Directional Relay. — A polarity-directional relay is one which functions by reason of a change in direction of polarity.

Phase-Rotation Relay. — A phase-rotation relay is one which functions by reason of a change in direction of phase rotation.

Current-Relay.—A current relay is one which functions at a predetermined value of the current. These may be either over-current relays or under-current relays.

Voltage Relay. — A voltage relay is one which functions at a predetermined value of voltage. These may be either over-voltage relays or under-voltage relays.

Power Relay.—A power relay is one which functions at a predetermined value of watts. These may be either over-power relays or under-power relays.

Frequency Relay. — A frequency relay is one which functions at a predetermined value of frequency. These may be either over-frequency relays or under-frequency relays.

Temperature Relay.—A temperature relay is one which functions at a predetermined temperature in the apparatus protected.

Open-Phase Relay. — An open-phase relay is one which functions by reason of the opening of one phase of a polyphase circuit.

Differential Relay.—A differential relay is one which functions by reason of the difference between two quantities such as current, or voltage, etc.

Note. — This term includes relays heretofore known as "ratio balance relays," "biased relays" and "percentage differential relays."

Locking Relay. — A locking relay is one which renders some other relay or other device inoperative under predetermined values of current, or voltage, etc.

Trip-Free Relay.—A trip-free relay is one which prevents holding in an electrically operated device such as a circuit breaker while an abnormal condition exists on the circuit.

Auxiliary Relay.—An auxiliary relay is one which assists another relay in the performance of its function and which operates in response to the opening or closing of the operating circuit.

Signal Relay.—A signal relay is an auxiliary relay which operates an audible or visible signal.

GENERAL QUALIFYING TERMS

Inverse Time. — Inverse time is a qualifying term applied to any relay indicating that there is purposely introduced a delayed action, which delay decreases as the operating force increases.

Definite Time. — Definite time is a qualifying term applied to any relay indicating that there is purposely introduced a delayed action, which delay remains substantially constant regardless of the magnitude of the operating force. (For forces slightly above the minimum operating value the delay may be inverse.)

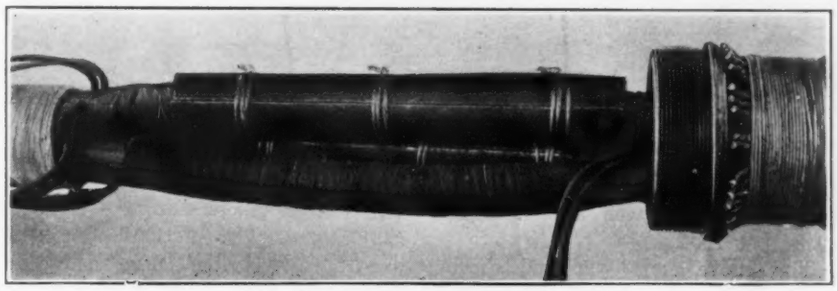
Instantaneous. — Instantaneous is a qualifying term applied to any relay indicating that no delayed action is purposely introduced.

Notching.—Notching is a qualifying term applied to any relay indicating that a number of separate impulses are required to complete operation.

FIELD EDITOR ELECTRICAL WORLD.
Chicago, Ill.

Eight-Mile Cable Under San Francisco Bay

Operated Successfully at 11,000 Volts by the Great Western Power Company—Method of Handling, Splicing, Testing and Laying Outlined

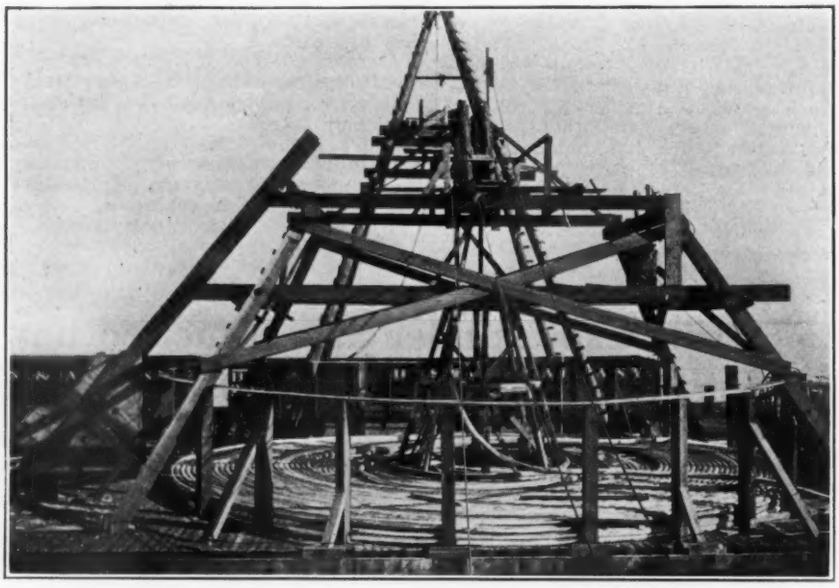


JOINT SLEEVE SCREWED TO THREADED COLLAR CLAMPED BENEATH CABLE ARMOR WIRE

WHAT is believed to be the largest and longest submarine power cable in the United States for operation at 11,000 volts has recently been laid by the Great Western Power Company. The cable, approximately 8 miles in length, runs beneath San Francisco Bay from Pier 41, San Francisco, and connects with the mainland near Richmond, Calif. Many unusual features are embodied, both in construction and in the method of laying that was followed.

The main cable is of the three-conductor type, each conductor composed of thirty-seven tinned copper wires and each wire having a diameter of 0.1162 in., with a total area of 500,000 circ.mils and an outside diameter of the copper strand of 0.813 in. Each of these conductors was insulated with special high-grade rubber compound of $\frac{2}{32}$-in. radial thickness. Over this rubber insulation was wound, spirally, a rubber-filled tape. The conductors, after vulcanizing, were laid up into a cable, the three interstices of which were filled with saturated jute and three pairs of telephone conductors. The telephone conductors are composed of No. 14 A.W.G. stranded tinned-copper wires, insulated with special high-grade rubber compound to a $\frac{3}{32}$-in. radial thickness. After insulating, each

telephone conductor was spirally wrapped with rubber-filled tape and vulcanized, then stranded into three separate pairs, the interstices of which were also filled with saturated jute. After laying up the three main conductors, three pairs of telephone conductors and saturated-jute fillers, the cable received a serving of rubber-filled tape. Over this tape two servings of saturated jute were applied, laid on in opposite directions. It was then armored with forty-three galvanized-steel wires, each wire having a diameter of 0.244 in., making the outside diameter of the cable approximately 4¼ in. The weight



CABLE COILED ON DECK OF VESSEL WITH FACILITIES TO PREVENT FOULING WHEN UNCOILED RAPIDLY

when completed was approximately 20 lb. per foot.

The shore ends were of similar construction, except that the conductors were composed of sixty-one tinned-copper wires, each 0.1109 in. in diameter, with an outside diameter of the strand of 0.998 in. and a total area of 750,000 circ.mils. The outside diameter over the armor, which in this case required forty-eight galvanized-steel wires, was 4.6 in. Over the armor was wound a saturated-marline serving, making a total outside diameter for the shore ends of approximately 5 in., with a total weight of approximately 24 lb. per foot. The length of the shore ends on the San Francisco end was 250 ft.; that on the Richmond end was 750 ft.

These cables were manufactured in Worcester, Mass., the deep-sea section being made up in lengths of approximately 5,000 ft. and coiled and shipped in gondola cars, this 5,000-ft. unit being the capacity of one gondola car.

The cable was tested in process at the various manufacturing stages at the mill, and then each carload received a final test for a period of five minutes while submerged in water at a test potential of 35,000 volts between each conductor and ground. While en route from Worcester, Mass., to San Francisco the different cars of cable averaged thirty days for the transcontinental journey and arrived in perfect condition.

Upon arrival in San Francisco the cable was joined into a continuous length and coiled on board a specially constructed barge designed to carry 1,000 tons. The method of coiling, jointing and laying the cable was developed by A. O. Hoeftmann and perfected during his period of service with the American Steel & Wire Company and in laying deep-sea transatlantic cables. A feature was the type of deep-sea cable joint employed. This, by its construction, permitted of easy passage over the guide sheaves, besides having practically the same tensile strength as the main cable and possessing great dielectric strength.

In the making up of this joint the copper-stranded conductors were connected by means of a special copper sleeve, the rubber insulation being tapered off on each end of this sleeve and a special rubber tape wound on —in other words, it was filled in with rubber slightly thicker than the original insulation—after which half-round steel molds were clamped over this new insulation and then the joint was put into a bath of compound heated to the proper temperature and was vulcanized.

The cable was taken from the cars, jointed and coiled upon the deck of the cable-laying vessel in a circular coil 42 ft. in diameter and with an inner diameter of 12 ft., the coil being approximately 6 ft. high. After the construction work for laying equipment was completed and the cable jointed and coiled on board in a continuous length, a final test was made before laying.

The cable, while in process of laying, passed from the coil around a cone in the center and in an upward direction to a series of shrouded sheaves; then through a trough and through a number of lever-operated brakes to a shrouded stern-piece, over which it passed into the water. The varying depth of the water determined the amount of brake friction necessary to control the speed of the cable while the barge was being towed by three large seagoing tugs. After laying approximately 6 miles of cable through deep water and strong tidal conditions at the start from San Francisco to beyond Alcatraz Island, the shallow water necessitated changing from the large tugs to three of lesser draft.

The entire operation of laying was carried out most satisfactorily, the cable being under control at all times, and no difficulty was encountered in maintaining the course as originally planned. The total time for laying the cable was two hours and thirty-seven minutes, making an average speed of about 3 miles per hour.

The services of A. O. Hoeftmann and J. J. Morrison, cable engineers, and John Marlborough, expert cable jointer, were obtained from the American Steel & Wire Company to superintend the installation of this cable.

J. A. KOONTZ,
Electrical Engineer.
Great Western Power Company,
San Francisco, Calif.

Grounding of Switchboard Instruments

WHERE meters and instruments are used with current and potential transformers, the Electric Power Club recommends that when the covers of the meters and instruments are connected to the secondary circuits and grounded the ground conductor need not be larger than a No. 12 B. & S. copper wire.

FIELD EDITOR ELECTRICAL WORLD.
New York, N. Y.

Central Station Business

Advertising, Selling and Service Methods
Commercial Organization and Management, Customer and Trade Relations, Public and Financial Policies, and Reports of Company Plans and Experiences

Marketing Central-Station Service

Sales Possibilities Have Been Overlooked in an Effort to Lower Manufacturing Costs—How the New-Business Department Should Be Organized

By Glen R. Trumbull
Head of New-Business Department, A. E. Fitkin & Company, New York

IT HAS taken a long time for the central-station company to realize that fundamentally its problems are the same as those of any other manufacturer—after the product has been made it must be sold. For years we have been so beset with tremendous engineering problems that the marketing of kilowatt-hours has been slighted. We were so eternally busy trying to manufacture energy at the lowest possible cost that we forgot the equally vital need of selling it at a profit.

We have been, and some of us are still, too content and satisfied with the natural increase in business; we expect the public to come to us with their demands and needs. It is fortunate indeed for some of us that there has been such a natural increase; that the public is alive and desirous of buying that which we have to sell, otherwise some companies' output and earnings would remain at a standstill.

New-business operations to function successfully require a regularly organized department with a specialist at the head, one who is trained to concentrate on the development of all the possibilities for increased gross earnings in the big field which exists in all of our communities today. Every property, no matter how small, needs the services of at least one man. Such a man, picked with an eye to two cardinal requisites of a good new-business man—common sense and industry—will approach his problem in the following general manner. He will first make a complete survey of the community served—every house, store, factory and plant—to find out these essential facts:

Who owns the property?
What is being used for illumination?
What is being used for fuel?
Is the place wired?
Is there gas service?
Is the service alive or dead?
What appliances are installed?
Are they in good working order and being used?
For what is the property an immediate "prospect?"

There are many more questions which, if time permits their compilation, will give a still more complete picture of the new-business possibilities—who and what the prospects are.

In the residence district this survey will show the number of dead services—a class of business on which to make the first drive and which it is the ambition of every live manager to see reduced to zero. Dead services not only produce no revenue but actually cost money because of the investment in equipment lying idle. This survey will also show the number of houses on lines not using service, which is the next best bet in desirable business. From this survey can be anticipated the most profitable extensions, those requiring the least expenditure for the greatest number of new customers. Finally the exact number of "prospects" for appliances can be determined and the particular one for which each customer is a prospect.

In the commercial or business district this survey will bring out the present low standard of illumination, the lack of realization of the average merchant and store keeper of what an important factor good and efficient illumination is in the appearance of the store and its direct relation to the net results of the cash register.

Importance of Lighting

Lighting yields approximately 59 per cent of the total operating revenue of the average central-station company, although it comprises only about 23 per cent of the total load. When one considers this fact it becomes apparent why the importance and value of the central station's lighting business cannot be too strongly emphasized.

Merchants everywhere today are in a most favorable frame of mind toward good illumination. Few will deny the importance of illumination in drawing and holding trade, and competition is keen—a big factor in making the merchant eager to invest in anything within reason that will make his store conspicuous and bring in new buyers. And so it is with window lighting and signs.

The average merchant thinks of lighting in terms of profit to his store. He is most easily "sold" on the idea that better illumination, which to his mind always means brighter illumination, will bring more trade. Merchants who have installed better illumination and electrical advertising cite many specific results, such as greater profit, fewer returned goods, improved courtesy and more regular attendance on the part of salesmen, the better sale of slow-moving gooods, the speeding up sales, greater cleanliness and better reputation of the store.

Electrical Advertising Must Be Sold

Electrical advertising is not confined to Broadway. In every city in this country there are progressive merchants as keenly alive to the value of electrical advertising as those in the larger centers, but they have got to be approached, they have got to be told the story, they have got to be "sold" by the central-station man.

But here is one fact: The poorest advertisement for electrical advertising is an old dirty sign hanging over the central-station office. How can we expect to interest others in the kind of advertising which we have to sell if we don't present a shining example at our own place of business? A central-station sign ugly from need of paint, with a lot of burned-out lamps, is as bad as no sign at all, worse if anything—it's a constant reminder to any prospective purchaser of what his sign may look

like a little while after its installation. As for window lighting, ours should always be the last word in luminaires and in intensity — the brightest in town—a working demonstration to influence storekeepers to more and better lighting.

THE CENTRAL STATION'S POSITION ON APPLIANCE SALES

Merchandising is recognized as and proved conclusively to be one of the most important and necessary functions of a live and up-to-date central station. Failure to press to the fullest extent the natural advantage any electric light and power company possesses in this line over any form of so-called competition is as bad as failure to install a new boiler at the plant which will reduce the coal consumption 2 lb. per kilowatt-hour.

Customers look to the company for advice and help in their purchases of those appliances and apparatus using our service. They expect us to sell the highest grade manufactured and to display a good variety of the standard articles which they have come to recognize as necessary for their comfort and many of which have become indispensable.

But to merchandise successfully a central station must put its salesroom and display windows in the same class with those of the successful merchants of the community. They must be brilliantly lighted with attractive and suitable fixtures. Appliances must be tastefully displayed, windows should be artistically and frequently trimmed, courteous and prompt attention must be accorded to prospective purchasers, and, most important, everything must be kept clean. It is sad but true that the average central station which thinks it is merchandising invariably neglects a few and sometimes many of these essentials.

With the public in a purchasing frame of mind, eager to buy electrical devices, and the manufacturers co-operating on a scale unknown and unheard of in other lines of industry, the majority of the central stations of this country are indifferent to or laggard in grasping their opportunity. The manufacturers are today spending hundreds of thousands of dollars annually in national advertising, sales plans, advertising literature and the services of demonstrators and expert salesmen, but how many of us take advantage of this help?

Success in merchandising is dependent on logically and intelligently planned sales programs and the employment of real salesmen. These salesmen are the representatives of the company. No official or employee in the entire organization is of more importance than he who sells and places appliances in the homes. His importance does not consist in the mere ability to fill a house with appliances. It is his ability to show that home how to get the largest possible benefits and advantages through the use of electricity. This man should be more than a mere solicitor. He is one of those who form the contact between the company and the community and therefore a big link in the chain that binds the company to its customers. And that chain is no stronger than his standing in the confidence and good will of these customers.

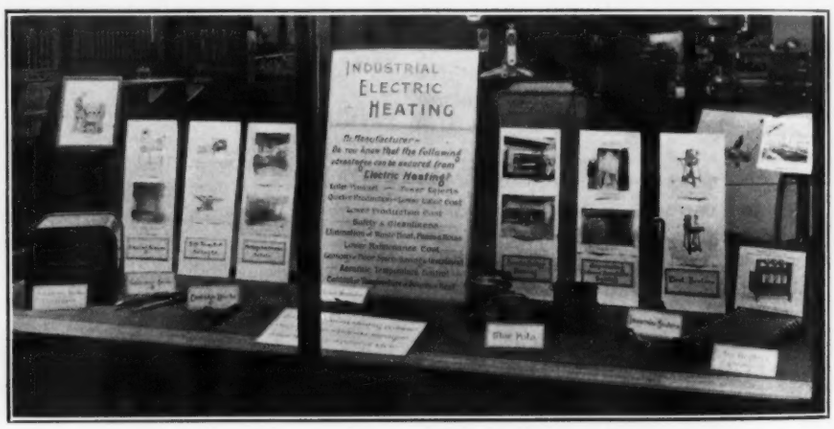
One thing more—there isn't such a thing as saturation, or even "near saturation," in public utility operations, least of all in new-business work. The history of one of the most successfully operated plants in this country—the one with the first regularly organized new-business department—in over twenty-five years shows a healthy increase in earnings year after year. The new-business department has never ceased its activities; it has grown larger and larger, and each year it continues to beat its record of the year previous. So it can be with every central-station company.

Range Load Growing Fast in Chattanooga

DURING 1922 the Tennessee Electric Power Company connected 333 electric ranges in Chattanooga by offering a combined lighting and cooking rate and selling ranges on the installment plan. For the first 40 kw.-hr. it charges 9 cents a kilowatt-hour and for all consumption above that it charges 3 cents. The average domestic bill for homes using electric ranges is $6.91 per month. The ranges have been connected despite the competition of coal at $8 to $12 per ton and gas at $1.50 per 1,000 cu.ft. In selling the ranges the customers are required to pay 10 per cent of the price down and 10 per cent per month. E. D. Reed is general superintendent of the Chattanooga district.

Promotion of Industrial Electric Heating Load

THE accompanying window display of industrial heating apparatus was used recently by the New York & Queens Electric Light & Power Company of Greater New York as a part of its program to inform manufacturers of the advantages of electric heating. Especial attention is being given by the company to the many applications of small units which in the aggregate mean a very considerable electrical load for the central-station company.



WINDOW DISPLAY SHOWS INDUSTRIAL HEATING APPLICATIONS

E. H. Hillock, industrial sales engineer of the company, plans to follow this display with additional exhibits at which other electrical apparatus about which industrial plants should be informed will be featured.

The commercial department of the New York & Queens Electric Light & Power Company foresees great possibilities for developing an industrial electric heating load in its territory, the latest addition being the installation of three electric brass furnaces, totaling 550 kw.

Tenney Management Gives Inside Utility Facts

A NEW series of public-relations advertisements was started early this year by the Haverhill (Mass.) Electric Company and the Montpelier (Vt.) & Barre Light & Power Company, under the general management of Charles H. Tenney & Company, Boston. The object is to expand the messages conveyed in last year's historical press displays to dimensions giving the local publics a straightforward, clear conception of the differences between the management of a private business and the conduct of a public utility, showing the limitations existing as to profits in the ordinary sense of the word in the utility field and pointing out the bearing which state regulation has upon company administration and development.

Referring to the accompanying reproductions of six Haverhill advertisements as so far scheduled, No. 1 has for its keynote a "tie-in" between the 1922 advertisements and the new series; No. 2 sets forth the real meaning of regulation as relating to prices of industrial products and of electric service, and No. 3 contrasts the profits permitted in ordinary business with those limited to the form of a return on capital invested in a public utility. The right of money to a fair return in the utility field is set forth in No. 4, and in No. 5 the real meaning of regulation is brought home to the business man by assuming its application to his own affairs. In the sixth display the part profits play in building up a great automobile manufacturing business is contrasted with the limitation placed upon public utilities, which must obtain their expansion through the investment of new capital. The series will be continued for a number of months according to present plans.

A new series of short talks

On a matter of vital importance to every citizen

FOR SOME TIME we have been telling you the story of the Public Utility—its origin, its purpose, its development in response to public need.

We now propose to tell you, in a series of short talks, how the Public Utility functions.

A Public Utility—just because it is a *public utility*—operates under conditions radically different from those that obtain in the ordinary private enterprise. Few people realize this fact. Yet it is a matter of vital importance to every member of the community.

It is our purpose, therefore, to tell you why a Public Utility differs from a private business, how it differs, and in what way this difference affects its relations with the public which it serves.

It is our hope that by presenting these facts we may help you to become better acquainted with this Company and with the problems that confront it in carrying out the task to which it is committed—furnishing a necessary service to this community.

HAVERHILL ELECTRIC COMPANY

You may have heard this one

But it's worth repeating. It illustrates an important point

ONCE upon a time—not so many years ago—the directors of a newly organized company held a very important meeting.

They were deciding whether to charge $1 or $5 for a patented article which the company was about to put on the market.

All the evidence indicated that they could profitably market the article for $1.

Nevertheless, they set the price at $5 and maintained it at $5 until their patents ran out.

This article undoubtedly saves its cost two or three times a year—and it lasts ten or twenty years. Therefore, men have asserted that the price was fair, that the inventor and the investors who made this article available to the public were entitled to a goodly return.

We do not venture to discuss the justification of that price. What we should like to point out is this:

If that company had been a public utility, it could not have charged $5. The law would have prevented it.

Massachusetts' Public Utilities are regulated by the state. The rates they charge are subject to the jurisdiction of the Public Service Commission.

HAVERHILL ELECTRIC COMPANY

John Jones may make business profits

A public service corporation may not

JOHN JONES receives a good salary.

He has $10,000 invested in gilt edge securities.

When John Jones goes into business for himself he expects certain returns from that business. He expects to get his salary—for he is his own employee. He expects to get the same interest on the money invested in his business as he got when it was invested in other businesses.

But he expects something more. Naturally. If he gets only the same salary and the same return on his investment, he gains nothing by going into business.

This something in excess of operating expenses and interest on investment is called business profits.

When you buy shoes or tooth paste or theatre tickets or automobile tires, you pay operating expenses and investment charges *plus profits*.

But when you buy electric light or power, no part of your money goes for profits.

The Haverhill Electric Company, like all public utilities, is regulated by the state. Its rates are subject to the jurisdiction of the Public Service Commission.

The rate you pay for light and power is simply your proportionate share of the cost of supplying such service.

HAVERHILL ELECTRIC COMPANY

FIRST SIX OF A SERIES OF PUBLIC RELATIONS ADVERTISEMENTS

Money, like men, works for profits or for wages

In the public utility industry it must work for wages

SOME men in business work for profits. These men may amass great fortunes. They take risks; but they are compensated for those risks by the opportunities for enormous returns.

Other men work for wages. Their remuneration is fixed. They can never amass great fortunes. On the other hand, so long as their services are required, so long as they render such services faithfully and efficiently, they are entitled to a sure and a fair return for their efforts.

Money is like men. Some money is risked for great profits. Money invested in private enterprises may earn 10 per cent or 100 per cent or 1,000 per cent.

But money invested in public utilities is on a wage basis. Its remuneration is limited by law. It is prohibited from earning business profits like money invested in private enterprises.

The money invested in the Haverhill Electric Company is necessary to provide light and power to the people of this community.

Since the service of this money is required, since that service is rendered faithfully and efficiently, since this money is prohibited from seeking profits like that in a private enterprise, since this money is therefore on a wage basis, is it not entitled—like any other wage earner—to a sure and a fair return?

HAVERHILL ELECTRIC COMPANY

"Public Regulation"

As applied to your business

YOU frequently hear the expression "public regulation." But does that phrase really have any vivid meaning for you?

Let's see what it would mean if applied to your business.

Suppose some public authority told your company what product it might make, what quality of product it might offer for sale, what price it might charge, how much capital it might have invested in its business—then your company would be under public regulation.

Massachusetts' public utilities are regulated by the state. The character of the service furnished, the rates charged for that service, the securities issued to provide the necessary capital—all are subject to the jurisdiction of the Department of Public Utilities.

The very existence of a modern community depends upon service rendered by public utilities. Under public regulation, wisely and justly administered, the interests of the public utility and the public served are adequately safeguarded.

Because of such regulation, a public utility necessarily operates under very distinct limitations—limitations that are in marked contrast to the freedom which a private enterprise enjoys.

HAVERHILL ELECTRIC COMPANY

What is an industrial genius?

And who contributes to his greatness?

A MAN starts a small business—making automobiles, let's say.

He sets a price on his product so that it pays all operating expenses, pays insurance and interest, pays dividends, allows for depreciation and contingencies, and leaves an excess of profits.

These profits, put into his business, permit him to operate on a slightly larger scale.

He continues this process of earning profits, putting them into his business, and operating on a larger and larger scale until he has built up a great industry.

That is a proper and admirable procedure. But let us not forget that the people who bought that man's products supplied the money necessary for the expansion of his business.

Let us bear in mind that a public utility is forbidden by law to follow that man's example.

Unlike the automobile business, the public utility cannot set a price on its service which will enable it to pay all costs of operation and in addition provide the money necessary for extending its plant.

HAVERHILL ELECTRIC COMPANY

Appliance Load in Small Cities

With Few Industrial Opportunities in Agricultural Sections, Residential Business Should Be Fully Developed—Increasing Lamp Wattage to Improve Lighting

BY ARTHUR HUNTINGTON
Iowa Railway & Light Company, Cedar Rapids, Iowa

DURING the past few years central-station companies, particularly in the smaller cities and towns, have placed many appliances with consumers. The independent dealers also have made heavy sales of them. A study of the replacement sales leads to the belief that there must be many of these appliances that are not in use. In the case of the electric flatiron one property having a record of the sale of about forty thousand irons shows a replacement sales record that indicates a life for the irons in use of approximately twenty-five years. More than thirty thousand sales were made prior to 1918. This record extends over so long a period that the replacement sales should be on a normal basis, provided proper use of the irons is being made.

The indications are that the same condition exists where other appliances are concerned. The largest single factor in the situation is probably the fact that appliances get out of repair and are set on the shelf until a convenient time of repair that never comes. A trial of the plan of sending out a man whose only business is to ferret out and repair such appliances indicates that not only can such appliances be returned to service, but the man can make a good wage day in and day out.

INCREASING LAMP WATTAGE

Another plan for developing business in the same communities is to promote better lighting both in homes and stores. In the case of a small Iowa town a check on lamp sales revealed that the average size of incandescent lamps sold was in the neighborhood of 27 watts, while 10-watt and 15-watt lamps formed the largest part of the stock on the dealers' shelves. In many cases a large part of the population of these small communities comes from the farms, and in others electric lighting is a comparatively new thing. The customers when they discard oil lamps use incandescent lamps that give a great deal more light than the previous utensils, and until they are educated to it they have no appreciation of the value or comfort of really good lighting. That educational work is the job of the central station as a part of its commercial activities.

Another appliance that promises much in the small towns is the electric range. Experience in the smaller towns of Iowa indicates that the customs are such that even when the days of the year are shortest there is no serious overlapping of the lighting and cooking loads. It has also been shown that in these small towns a heavy range load can be handled with no increase in the cost of the distribution system over that of the haphazard system ordinarily used in supplying lighting customers. Application of engineering principles has accomplished this in cases where a deliberate development of the range business has been undertaken in small towns.

EDUCATION OF CUSTOMERS

Central station companies' experience in the use of the range has extended over a long enough period to show that there is no serious obstacle to it from the cost standpoint. The biggest factor in this phase of the problem is the education of the customer to an intelligent use of the range. In the case of two small towns, one paying a 5.4 cent rate and one a 4.5 cent rate per kilowatt-hour, the revenue per range is practically the same and there is no dissatisfaction. Rates have cut less figure than proper education.

These three items may not appear to be big ones in the commercial policy of a central station. In sections where industrial developments are large they will be of less importance. But in the smaller cities in agricultural sections they form avenues along which the biggest development of the business must take place. Many small companies have spent time and effort in securing all the possible customers in their territory and have forgotten that use of service is the only means of building up the business. These three items form the biggest possibility of consumer development in much of the agricultural territory of the Middle West because there are no industrial developments from which to build up a power load. Experience indicates that in many small towns the consumers already connected can be profitably developed beyond the ordinary limits of consumption so that the company will receive more than would be received from the average ordinary new customer, for whom an additional investment would have to be made.

What Other Companies Are Doing

Indianapolis, Ind. — A campaign to sell 2,500 shares of prior-lien stock of the Interstate Public Service Company was started by the company's investment department on Jan. 18. Prizes will be distributed to employees for the largest single sale, largest number of sales and for the greatest number of shares sold.

Hartford, Conn. — The Hartford Electric Light Company has arranged to alter the third and fourth floors of its office building to provide a dining room for the women employees and officers of the company. A pool room and rest rooms will also be provided.

Franklin, Mass. — During December the Union Light & Power Company's business in a territory with four thousand customers was in excess of $10,000, or over twice the business of December, 1921. During the past year this company has paid special attention to the development of industrial heating applications and heavy-duty types of electric range service for lunchrooms, new roadhouses, etc., and this work will be pushed this year with electric refrigeration.

Greeley, Col. — Colorado's third electrical home was opened here from Jan. 5 to 12 with an attendance of 5,027 during the eight days. The total cost to the electrical interests was less than $400. The individual cost per person inspecting the home was less than 7 cents and the total attendance represented 45 per cent of the population.

Seattle, Wash. — According to data presented at a recent convention of Stone & Webster, Inc., managers at Boston, employees of the Seattle division of the Puget Sound Power & Light Company oversubscribed a preferred stock allotment of $200,000 by 12 per cent in a campaign last year. The total number of employee subscribers was 1,240, despite the fact that the company had previously sold $668,000 of five-year 8 per cent notes to 2,000 employees.

Digest of Electrical Literature

Including Brief Abstracts of and References to
Important Articles Appearing in the Scientific and Engineering Press
from All Parts of the World

Hydro-Electric Development and Steam Equipment

Power-Plant Extension.—The Walsall Corporation (England) has increased its 14,000-kw. station at Birchills by adding a 5,000-kw. Brush-Ljungstrom turbo-alternator set. Several interesting tests on this set have been completed. The accompanying table shows the results obtained from

TEST ON 5,000-KW. BRUSH-LJUNGSTROM TURBO-ALTERNATOR SET

Average load, kw.	5,030
Steam pressure, lb. per sq.in.	166
Steam temperature, deg. F.	662
Vacuum (barometer 29.95 in.), in.	28.90
Cooling water temperature:	
Condenser inlet, deg. F.	49
Condenser outlet, deg. F.	61
Average condensate per hour, lb.	52,100
Steam consumption, lb. per kw.-hr.	10.36

the set over a test lasting six hours. For this test the load varied from 3,700 kw. to 5,415 kw., and the coal consumption was 1.92 lb. per kw.-hr. generated, its calorific value being 10,160 B.t.u. per lb. and the thermal efficiency 17.49 per cent.—*Electrical Review*, Dec. 29, 1922.

Steam Engineering Practice in Modern Central Stations.—T. E. KEATING.—The upper limits of pressure and temperature for a central generating station are set by the materials commercially available and, with the exception of financial considerations, are determined wholly by conditions within the plant. For these reasons steam pressures and temperatures have not reached the stage of standardization prevailing in electrical units. This article discusses a few of the thermal and operating problems that are today under consideration by central-station engineers, explaining their influence on the economic generation of power in modern central stations. — *Electric Journal*, December, 1922.

Generation, Control and Instruments

On Booster Transformers.—J. SAHULKA.—It is shown that if feeders are connected to a line and their voltage is to be increased or decreased with the aid of a booster transformer, it is sufficient to equip this transformer with a primary winding dimensioned for only the difference of the energy corresponding to the amount of "buck" or "boost."—*Elektrotechnik und Maschinenbau*, Dec. 24, 1922.

A Magnetically Self-Locking Disconnecting Switch.—VLADIMIR KARAPETOFF.—It has been found that the usual mechanically locked switch has been unsatisfactory in high-current work because of the high magnetic stresses set up. The author has developed several switches in which a magnetic field aids in holding the switch in place. This is accomplished by placing coils above and below the switch blades in such a manner that the flux tends to hold the switch in place.—*Sibley Journal of Engineering*, January, 1923.

Transmission, Substations and Distribution

Electrical Oscillations on Lines.—LOUIS COHEN.—The subject of electrical oscillations on telephone, telegraph and power transmission lines is so large and complex that any new presentation which will help to make it more intelligible to engineers and perhaps facilitate the solution of the many problems involved should prove of value. It is claimed that the methods developed in this paper for the solution of this class of problems offer many advantages in the matter of directness and simplicity. A limited number of cases are worked out, but the method is applicable to the solution of many others.—*Journal of the Franklin Institute*, January, 1923.

Heating of Polyphase Cables with Metallicized Sections.—C. FELDMANN.—Polyphase cables have recently been used in America the individual conductors of which were covered with a layer of copper ribbon 0.1 mm. thick. It was found that such a cable had a smaller dielectric loss and carried more current than an equivalent cable without the copper ribbon. Similar cables with a layer of zinc or aluminum ribbons 0.03 mm. thick have been used in Europe. The author gives a simple approximate method for calculating the heat resistance of such a metallicized cable which permits of drawing conclusions as to its higher current-carrying capacity. The author illustrates his calculating method on six actually built metallicized cables, three with a copper and three with a zinc ribbon, and finds that the cables with the copper ribbon may carry 38 per cent more current and the ones with zinc ribbon 15 per cent more current than similar cables without these ribbons. The method for drawing isotherms for three-phase cables is given in an appendix.—*Elektrotechnische Zeitschrift*, Dec. 21, 1922.

Units, Measurements and Instruments

Power Losses in Insulating Materials.—E. T. HOCH.—It is shown that a satisfactory measure of power loss in a dielectric is the product of phase angle and dielectric constant. Although the dielectric constant need not be explicitly considered in the design of condensers, it is important in such cases as the design of apparatus panels and vacuum-tube bases. The method used in measuring phase angle and dielectric constant is explained.—*Electrical Communications*, Vol. I, No. 2.

Tables for the Calculation of the Inductance of Circular Coils of Rectangular Cross-Section.—F. W. GROVER.—The tables presented in this paper are calculated from accurate formulas, more than one formula having been used wherever this was possible as a check on the results. The tabulated values are correct to one part in ten thousand, and even where a double interpolation has to be made, the error is less than one part in a thousand. If desired, curves can be constructed from the data of the tables, with, however, a sacrifice in accuracy. Examples are given to illustrate the use of the tables and formulas in practical cases, and the application of the tables to the calculation of the mutual inductance of coils of rectangular cross-section is treated and illustrated and the necessary formulas developed. The formulas on which the tables are based are collected for reference in an appendix.—*Scientfic Paper No. 455 of the Bureau of Standards.*

Illumination

Illuminating Engineering Society Paper.—This issue of the *Transactions* includes six papers that were presented at the Swampscott convention last fall. An abstract of the following four may be found in the convention report in the Oct. 7 issue of the ELECTRICAL WORLD, pages 760 and 761: "Relative Performance of Tungsten-Filament Lamps," by J. W. Lieb; report of the committee on motor vehicle lighting, "Influence of Daylight Illumination Intensity on Electric Current Used for Lighting," by A. Smirnoff, and the report of committees on nomenclature and standards. The other two, "Direct Reading and Computing Attachment for Sphere Protometers," by B. S. Willis, and "Plotting of Spectrophotometric Data," by F. A. Benford, may be found abstracted in the Oct. 21 and Oct. 14 issues, pages 892 and 835, respectively.—*Transactions of the Illuminating Engineering Society*, January, 1923.

Motors and Control

Practice in Maintenance Work.—E. H. HUBERT.—Among the questions answered in this survey of seventy-four industrial plants are what to include in the maintenance work, method of handling maintenance, frequency of inspection for different equipment, most frequent causes of motor failures, and the character and amount of parts and supplies to keep in stock for all maintenance work.—*Industrial Engineer*, January, 1923.

Water-Pumping Station in Württemberg.—O. GROSS.—A general description is given of a large water-pumping station for the supply of several cities. Its output is about 65,000 cu.m. of water per day, pumped to a high-

est level of 148 m. The station contains five sets of centrifugal two-stage pumps, each driven directly by a three-phase induction motor at 985 r. p. m. To give the greatest possible flexibility of service according to water requirements, each pumping set is of a different size, varying from 540 hp. to 1,500 hp. A section is shown of the largest pump. To be insured against a total breakdown in the case of a failure in the 50,000-volt, three-phase feeding line, a sixth pumping set is installed, driven by a Diesel motor.—*Zeitschrift des Vereines Deutscher Ingenieure*, Dec. 9, 1922.

Electric Equipment of Oil Wells in Rumania.—C. REY and M. WILFART.—The authors describe the drilling methods used in Rumania, the necessary tools and the average cost of a new well. Three-phase motors are used throughout. All switches and controlling apparatus are of the oil-submerged type such as is used in mine practice. As an example full details are given for a reversing controller to operate a wound-armature, three-phase, slip-ring motor. — *Revue Générale de l'Electricité*, Dec. 16, 1922.

Heat Applications and Material Handling

Welding as a Factor in Steel-Plant Maintenance. — E. R. NORRIS. — The welding practice of the Pittsburgh Steel Company is described in this paper.—*Journal of the American Welding Society*, December, 1922.

Better Methods of Handling Materials.—F. E. GOODING.—Trends and developments in better methods of handling materials which may be adopted in industrial works to increase production and reduce costs are described. The author asserts that whenever reduction in costs and increases in production are being studied, or when it is desired to put production on a more even flow of work, with schedules and a dispatching system to route it through the plant, it is well to investigate all the available methods for handling materials. — *Industrial Engineer*, January, 1923.

Electrophysics, Electrochemistry and Batteries

Primary Cell with Air Depolarizer.—M. FOURNIER.—During the war, when manganese bioxide became very scarce, a new primary cell for telegraph purposes was developed in France, known as the Fery cell. It consists of a glass vessel containing at the bottom a zinc plate above which hangs a large carbon block. A solution of ammonium chloride serves as electrolyte. During operation heavy chloride of zinc is formed around the zinc pole, while lighter NH_4OH is formed along the carbon, rising to the surface of the liquid. The author claims that prolonged tests, extending over two years, showed a remarkable superiority of these Fery cells over the manganese batteries that had previously been generally used. To compare the Fery cell with two known manganese-type cells, one of each was closed over a 50-ohm resistance, and the voltages given in the accompanying table were observed.—*Revue Générale de l'Electricité*, Dec. 30, 1922.

Type	Initial Voltage	Length of Test, Days	Voltage at End of Test	Voltage Drop per Ct. per Day
Carbon in porous container with zinc rod	1.46	45	0.74	1.16
Carbon in bag, concentric zinc cylinder	1.52	45	0.70	1.11
Fery cell	1.25	100	0.625	0.50

Effect of Temperature on the Mechanical and Microscopic Properties of Steel.—G. C. PRIESTER and O. E. HARDER.—An investigation to study the mechanical properties of steels at elevated temperatures, the properties of the same steels at ordinary temperature after they have been heated to various drawing temperatures and the correlation of these properties with the microstructure of the steels has been carried out by the authors. It was found that the properties of a low-carbon steel in the blue heat range are inherent to that temperature and not duplicated when the same metal is tested at room temperature after a corresponding tempering. The actual results are shown by suitable curves and tables.—*Chemical and Metallurgical Engineering*, Jan. 17, 1923.

Traction

A 400-Hp. Swiss Motor Car.—For a combination adhesion and cog-rail road of 3-ft. 3-in. gage a special motor car of the "D" type is described in this paper. The 40-ton car rests on two trucks of four wheels each, with one motor of 100 hp. driving each of the four shafts with double reduction gearing. On the grades of 20 per cent (cog-rail sections) a speed of 4.3 m.p.h. is obtained by operating the four direct-current motors in two groups in series, running at 460 r.p.m; on 7 per cent grades (adhesion sections) all four motors run in parallel at 1,160 r.p.m. The tractive effort is 8,800 lb. per pinion on the rack section and 3,400 lb. on the adhesion parts. Five independent brakes and a magnetic rail brake are provided on the car. One of them is governor-controlled and sets automatically if speed exceeds a permissible maximum. With a train of 57 tons weight an amount of heat of over 30,000 B.t.u. has to be dissipated in the resistances from current regenerated from the motors on the down-grade haul. Why this large amount of energy is not fed back into the line is not apparent from the paper. The emergency magnetic rail brake, with a magnetic pull of some 8,000 lb., can stop a train of 77 tons running at 7 m.p.h. on the 7 per cent section within 55 yd. —*Bulletin Oerlikon*, December, 1922.

Electric Traction Developments in 1922.—The most notable development in electric traction in the United States during the past year was the decision of the Illinois Central Railroad to adopt the 1,500-volt direct-current system with overhead trolley for the electrification of the Chicago terminal district. Other activities in this country were confined largely to equipment orders. Greater activity has been shown abroad, such as the extensive electrification by the South African government railway, the electrification of the harbor railway terminals in Montreal and various projects initiated in Japan, England, Sweden, Norway, Switzerland and France. — *Railway Electrical Engineering*, January, 1923.

Telegraphy, Telephony, Radio and Signals

Practical Alternating-Current Radio Receiving Tube.—H. M. FREEMAN.—A new tube has been developed for radio service which may be used in ordinary receiving and amplifying circuits with alternating current on the filament. A general description of this tube is given.—*Electric Journal*, December, 1922.

Telephone Repeaters. — BANCROFT GHERARDI. — A description of the various types of telephone repeaters which have been designed and their operating characteristics is followed by an account of the application of the telephone repeater to the telephone art.—*Electrical Communications*, Vol. I, Nos. 1 and 2.

Signaling Apparatus for Substations. —P. KANNENGIESSER.—The commonly used optical or acoustical signal systems light a lamp or sound a horn in case trouble occurs such as the opening of a circuit breaker, the overheating of a transformer or the discontinuance of the flow of cooling water. On proceeding to remedy the trouble the attendant switches off the light or stops the noise of the horn, often forgetting to readjust these devices again so that they will be ready for the next trouble. The paper describes an alarm system which resets the device automatically.—*A. E. G. Mitteilungen*, December, 1922.

Observations of the Field Strength of the Horsea (England) Wireless Station. —E. B. MOULLIN. — Many measurements are recorded of the strength at Cambridge of the signals from Horsea during September, 1921, in which the Vallauri method of measurement was employed. The field strength is deduced from the measured electromotive force of the signal, the effective height of the receiving aërial being determined experimentally both from the distribution of current in the aërial up-lead and by comparing the receptive power of the aërial with that of a loop. Incidentally, the measurements of effective height provide a very accurate verification of the law that for short distances the electromotive force set up in an aërial is in direct proportion to the frequency of the incident waves. It was found that at a wave length of 3,000 m. the Horsea signals suffer an absorption of 40 per cent.—*Institution of (British) Electrical Engineers*, December, 1922.

Scientific and Industrial Research

A Department Devoted to Reports of Investigations Contemplated or Completed, Research Facilities Available and Suggestions for Co-operative Work

Conducted by PROF. VLADIMIR KARAPETOFF, *Cornell University, Ithaca, N.Y.*

[PRINTED IN THE THIRD ISSUE OF EACH MONTH]

[When investigations which have been completed are, in the opinion of the editors, of wide enough interest to the field we serve, details thereof will be presented in other parts of this paper. Contemplated research or that which appears to have limited apppeal will be only briefly reported in this section, but details may be had by communicating with the investigator or institution named in the report. Readers are referred to the department "Digest of Electrical Literature" for investigations reported in other journals. The news and engineering sections should also be followed for research reported before technical societies.]

Research Completed

Bushing, Condenser Type, for 1,000,000 Volts.

The bushing for the one-million-volt transformer is more than 18 ft. high and weighs nearly 7 tons. The insulation consists of paper strip wound spirally on a 6-in. steel pipe. Layers of metal foil, also in strip form, serve to grade electrostatic stresses properly. The radial thickness of insulation is less than 18 in., and yet the bushing has been calculated to stand 2,000,000 volts for short intervals of time. Both ends are fitted with static shields in the form of torus rings, the upper one being 10 ft. in diameter. The part of the bushing in the air is surrounded by an insulating tube and the space filled with insulating gum.—*J. F. Peters and D. F. Miner, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.*

Flash-Over Voltage, Effect of Surface Permittivity on.

Toepler has found (*Elektrotechnische Zeitschrift*, 1921, Vol. 42, page 1381) that under certain conditions the flash-over distance along a glass plate is proportional to the fourth power of the applied impulse voltage and to the 1.5th power of the capacitance of the plate per unit surface. To prevent flash-over the material of the plate must be of as low permittivity as possible and the thickness as great as possible, in order to reduce the flash-over distance with a given voltage. This relationship does not seem to be generally known and may prove to be useful in the design of high-voltage apparatus, especially for high frequencies.

Friction Tape, Pinholes in.

Owing to imperfect impregnation, friction tapes often show pinholes, so that in cases where the tape is expected to have considerable insulating properties a sample should be held before a strong light to detect the presence of any great number of these holes. A maximum number of three holes is allowable per yard of tape, but a well-impregnated tape will usually have a much smaller number or none at all.—*Hydro-Electric Commission, Toronto, Ont.*

Lighting, Direct Versus Indirect.

Experiments were made on twenty-six trained college seniors to determine the best intensity of illumination for reading. The average of the answers was 2.8 and 4.0 ft.-candles with the direct and indirect illumination respectively. It is thought that a greater intensity is needed with indirect lighting because the pupil of the eye contracts more because of the uniform illumination of the surrounding objects.—*William Kunerth, State College, Ames, Iowa.*

Magnetic Field, Measurement of.

A two-electrode cylindrical tube is connected in multiple with a standard voltmeter and in series with a high resistance and a source of voltage. The tube is placed in the field and rotated until the voltmeter reading is a maximum. The direction of the field is then given by the direction of the axis of the tube, and its magnitude H by the voltmeter reading V, according to the equation $H = (6.72/R)$ V, where R is the radius of the anode. Fields from 20 to 500 gausses can be measured. By using a symmetrical tube and a polarizing field coil around it the range may be extended down to 0.1 gauss. *A. W. Hull, Research Laboratory, General Electric Company, Schenectady, N. Y.*

Pyrometers.

A committee, with Dr. George K. Burgess as chairman, has devoted attention to improvements in pyrometry, including the measurement of the temperature of the bath of steel in open-hearth and electric steel-making processes. The industry cooperated in the experimental work. A symposium of fifty-seven papers was published in a separate volume by the American Institute of Mining and Metallurgical Engineers. This is considered the most important contribution to pyrometry since the invention of the Le Chatelier pyrometer.—*National Research Council, Engineering Division, New York City.*

Transformer, 1,000,000-Volt.

A single-unit, 1,000-kva., 1,000,000-volt transformer for testing purposes has been built and tested. High-voltage coils are wound on concentric micarta tubes of increasing diameters and decreasing lengths. This automatically places the highest-voltage coil farthest from the grounded core. The distribution of stresses is similar to that in a condenser-type bushing. The coils on the two legs of the core are alternately connected in series to obtain a more uniform distribution of electrostatic field.—*J. F. Peters and D. F. Miner, Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.*

Wattmeter, Elimination of Correction for Phase Angle.

If both the current and the potential winding of a wattmeter are made of two sections which may be connected at will either in series or in parallel, two readings can be taken from which the correction for the phase angle in the potential winding can be eliminated. With this method more turns may be placed on the moving coil, making a more sensitive and robust instrument. Moreover, much more accurate readings can be obtained at low values of power factor and at high frequencies. For details see *Comptes Rendus*, 1922, Vol. 174, page 1007.—*H. Chaumot, Paris, France.*

[This method should be of interest in the measurement of dielectric losses.—EDITOR.]

X-Ray Tubes, Crest Voltmeter for.

Of the crest voltmeters, of which the writer has made an extensive study, that of Fortescue, employing a condenser, a rotating commutator and a milliammeter at ground potential, is the only one found suitable for X-ray work. This meter, functioning directly, in the high-tension circuit, responds to every change in the secondary voltage due to any reason whatever.—*Munford Morrison, New York City.*

Research in Progress

Communication Over a 220-Kv. Transmission Line.

It is very essential that adequate and reliable communication be maintained between the larger generating and more important distribution centers. Where the distance of transmission is as great as it is to Pit River the investment in the ordinary metallic communication circuits runs into large sums. The ordinary wireless system of communication has many commercial disadvantages, but we hope, by the use of the wired wireless over our power circuits to establish, at a considerably lower cost, a system of communication that will materially reduce our investment.—*P. M. Downing, Pacific Gas & Electric Company, San Francisco, Cal.*

Fuses, High-Tension, Repeating.

The writer is continuing to develop his system of high-tension repeating fuses for transformer stations and branch lines.—*L. M. Klauber, Consolidated Gas & Electric Company, San Diego, Cal.*

Insulating Materials, Fundamental Study of.

A committee was organized under the chairmanship of Dr. F. B. Jewett, not for the purpose of developing new insulating materials nor to solve specific industrial problems, but rather to lay a foundation of fundamental knowledge of the phenomena on which solutions of practical problems can be based.—*National Research Council, Engineering Division, New York City.*

Paints, Preservative.

We have under way an extensive series of tests, (a) to determine the lasting qualities of various pole and cross-arm paints; (b) to find the best pole preservatives, in particular for the protection of poles from white ants or termites; (c) we are making a study of paints and preservatives for general plant service, based on certain gas-plant residuals; (d) we are working on the perfection of the protective covering of steel pipe laid underground, particularly where corrosive soils are found.—*L. M. Klauber, Consolidated Gas & Electric Company, San Diego, Cal.*

Sand, Inundated, Measurement of.

An investigation has been started to determine the feasibility of measuring sand for concrete in an inundated condition. With small additions of moisture, the quantity of sand in a given measure varies greatly with the amount of moisture. There is a reason to believe that with sufficient water in a measure to submerge the sand the quantity of sand becomes independent of the original moisture in it. A successful solution would insure uniformity in the proportioning of sand to cement and consequently uniformity in the strength of concrete. This is one of the most troublesome problems in the concrete industry—*Bureau of Standards, Washington, D. C.*

Transmission at 220-Kv.

Our most important work is that in connection with the utilization of 220,000 volts for the transmission of power. This voltage being so much higher than any voltage ever before undertaken, its use involves a great deal of study and investigation.—*P. M. Downing, Pacific Gas & Electric Company, San Francisco, Cal.*

Suggestions for Research

Cables, Power Loss in Sheaths.

Sheath currents in single-conductor cables may reduce the carrying capacity of the cables by 10 or 15 per cent, the amount of the reduction depending upon the spacing of the cables, the thickness of the insulation and the size of the conductor. The losses in the lead sheaths must also be taken into consideration in calculating the efficiency of the transmission as they may be greater than the dielectric losses. The data heretofore published have been insufficient to make accurate calculations of these losses.—*A. I. E. E. Cable Research Committee.*

Insulators, Pin-Type, Standardization of the Rating of.

A standardization of the rating of pin-type insulators on a basis of leakage distance, flashover and other physical characteristics, eliminating the nominal voltage rating, appears highly desirable.—*A. I. E. E. Committee on Transmission and Distribution.*

Sphere Gap, Inaccuracy in Grounded.

In the *Journal* of the (British) *Institution of Electrical Engineers*, Vol. 57, page 223, Dr. Alexander Russell has pointed out certain discrepancies between the theoretical and observed values of the spark-over voltage when one of the spheres is grounded. A controversy between him and F. W. Peek, Jr., was published in the ELECTRICAL WORLD, Vol. 77, page 1427, and Vol. 78, page 469. The matter was not finally settled, and it would be of interest to perform the crucial experiments suggested by Russell at the end of his letter.

News of the Industry

Chronicle of Important Events and General Activities, Announcements and Reports of Association Meetings, Court Decisions and Commission Rulings and News of Electrical Men

Canadian Plant with Large Electric Boiler Load

Work has begun on a 120,000-hp. development on the St. Maurice River in the Province of Quebec, Canada. The project will be owned by the St. Maurice Power Company, which is closely allied with the Shawinigan Water & Power Company of Montreal. A bond issue of $10,000,000 has just been floated by the company on the property.

The hydro-electric plant will be located at La Gabelle, about 6 miles below Shawinigan Falls. It will operate under a head of approximately 65 ft. and is scheduled for completion about October, 1924. The dam across the St. Maurice River at La Gabelle will back the water up to the tailrace of the hydro-electric plants at Shawinigan and will have special gates for use in time of floods.

At first a general load of 30,000 hp. will be available, and the remainder of the power generated will be used in electric boilers for making steam, for which there is a great demand in the pulp and paper mills of the vicinity. It is anticipated that power for this purpose can be sold at from $9 to $10 a horsepower-year, depending on the price of coal. Such a rate, it is said, will be sufficient to carry the fixed charges on the installation until other load can be obtained. The advantage claimed for such a disposition of the power is that it enables the full development to be made at once, the electric boilers being used to absorb all the idle power available. The water turbines will be built by the Dominion Engineering Works, Ltd., of Montreal. The engineering is in charge of Julian C. Smith, Power Building, Montreal, Canada.

Lightning-Arrester Committee Sees Steinmetz Tests

The lightning-arrester sub-committee of the protective devices committee of the American Institute of Electrical Engineers held a meeting on Feb. 12 at the Schenectady works of the General Electric Company, witnessing tests of arresters in the general engineering laboratory test department.

There was a demonstration in which the Steinmetz lightning generator was used. The tests were made to show the effects of high and low discharge rates in an arrester. This test and others involved a maximum of 120 kv. at about 5,000 amp. making use of the Steinmetz apparatus. Blocks of wood were split by the Steinmetz artificial "lightning" during the test. Protection tests for a 15,000-volt insulator were also held. These showed that when the insulator was protected by a high-discharge-rate arrester the lightning discharged through the arrester, but when a low-discharge-rate arrester was used a flashover occurred. Another test showed the difference between testing lightning arresters with a high-frequency oscillator at the same voltage but rated at only about 0.75 amp. and testing them with the Steinmetz generator, the effect on different types of insulation being noted.

State Chamber of Commerce Opposes Smith's Policy

Delegation to municipal bodies of the regulative powers over public utilities now exercised by the state, as proposed by Governor Smith of New York, is characterized as "reactionary" and a "retrogressive step opposed to the best interests of the people" in a report of a committee on public service approved by the Chamber of Commerce of New York State. The report points to nation-wide investments in public service enterprises in New York State aggregating a billion dollars. These investments, it says, were made in reliance on a system of just and impartial state regulation, and a return to old conditions would be a breach of faith and render it difficult for the utilities to raise new capital.

New York State Commission Legislation Delayed

Following the introduction of the transportation bill favored by Mayor Hylan of New York, which aims to abolish the present Transit Commission appointed by Governor Miller for that city and substitute a Transportation Board appointed by the Mayor and controlled by the city's Board of Estimate, the main public utility commission bill of the new state administration was, according to announcement from Albany, to have been introduced into the Legislature on Wednesday of this week. After the bill was prepared, however, it was withheld for further conference, and it had not made its appearance up to the time the ELECTRICAL WORLD went to press.

This bill, as previously told in these pages, will aim to restore "home rule" in the control of utilities contained within city limits to all the cities of the state, permitting them to set up new governing bodies for this purpose, to utilize municipal bodies already existing, or, if they should so elect, to leave control with the state commission.

Awards Under Coffin Foundation Soon to Be Made

Frank W. Smith, as president of the National Electric Light Association and chairman of the Charles A. Coffin prize committee of that body, has issued a letter to all central-station companies in the country inviting them to participate in the awards to be made under the terms of the Coffin Foundation as established by the General Electric Company and announcing further details. He says:

"The announcement, in so far as it refers to the central-station industry, is broadly interpreted by the committee as providing for the annual award of the Charles A. Coffin medal to the public utility operating company within the United States which during the year has made the greatest contribution to the development of the general use of electric light and power by the public and to the benefit of the industry.

"Every electric light and power company in the United States is invited to participate and urged to send to the undersigned committee a presentation of its activities and accomplishments covered by the field of the award.

"The committee suggests that among the factors which will be considered in making the award are the following: The particular initiative, skill and enterprise which have been manifested in popularizing the general use of electrical energy; accomplishments in the development of the efficiency of your organization, improvements in construction practice which have resulted in greater reliability of service, marked increases in the efficiency of generation and distribution, the adoption of special plans which have resulted in the largest percentage of increase in new customers, methods adopted of interesting customers in stock ownership, unusual efforts and accomplishments in popularizing and introducing domestic appliances, and extension of service to homes not previously wired and to rural communities.

"The first award of both the medal and the thousand dollars for the central-station company's employees' benefit fund will be made in the year 1923. The announcement of this award will be made at the annual convention of the N. E. L. A. in New York City, June 4 to 8.

"All statements must be in the hands of the committee by March 15. Kindly address these to the Charles A. Coffin Prize Committee of the National Electric Light Association at 130 East Fifteenth Street, New York City."

A. I. E. E. Holds Two-City Meeting

Chicago and New York Listen to Same Addresses Carried by Long-Distance Telephony—Large Attendance at Midwinter Convention in New York from All Parts of the Country

WITH a surprisingly large attendance of members—approximately seven hundred had registered up to Thursday noon—from all portions of the United States, the American Institute of Electrical Engineers held a most successful and active midwinter convention at the Engineering Societies Bulding in New York this week. One of the outstanding features of the gathering was the joint session with Chicago on Wednesday evening, when two-way loud-speaking telephone installations were used at each city so that the two audiences, separated nine hundred miles, heard all the proceedings of the joint meeting. In addition, everything that was said at either end of the line was broadcasted. One thousand persons were present at the divided meeting.

At the various sessions of the convention papers of the high caliber usual at Institute meetings were presented according to a prearranged schedule, which allowed ample time for discussion. The smoker on Thursday evening and the annual dinner-dance on Friday evening were well attended and scored the customary success. The usual number of inspection trips were arranged for delegates and guests during and after the convention. Among these trips was one to the offices and plant of the McGraw-Hill Company, publisher of the ELECTRICAL WORLD and other technical papers, where delegates to the convention were entertained at luncheon on Thursday noon. Visits to New York power houses and telephone and broadcasting exchanges of the American Telephone & Telegraph Company were some of the other trips.

PRESIDENT JEWETT'S ADDRESS

In opening the convention President Frank B. Jewett paid tribute to the ever-increasing effectiveness of electricity in the service of mankind. The extensive technical program of this convention, he said, was an example of the return to highly technical subjects in the last few years. This may be due to the necessary restriction of technical research and development during the war to certain channels, or it may be due to the opening of new fields to electrical application. In the communication field the great activity, the speaker thought, was chiefly due to the intense popular interest in radio.

Elaborating on the latter topic at Wednesday night's session, Mr. Jewett said in part: "We can hardly picture the limits of the effects and influences which will flow from the developments of electric science which have made this night possible. In truth, we are participants in a historical event and our children, nay even many of us, may see the agency we here use employed with mighty effects in controlling our collective relations in state and nation.

"Some one has said that the greatest political engine ever devised was the colonial town meeting, where every question of importance was debated and discussed in the open forum of all the citizens. Be that as it may, we are well aware that our best government today is found in those small political units where the town meeting in some form is feasible and still persists. It is only when we come to the larger units of city, state and nation that the limitations of common discussion of vital matters, which are imposed by sheer physical size, evidence themselves in cumbersome and inadequate substitutes for personal discussion and ofttimes in unsatisfactory results.

"May it not be that in this two-way working telephone, with its sensitive transmitters and loud-speaking receivers, we have the instrumentality for insuring a simpler and better ordering of our affairs—an instrumentality which will enable us to derive many of the benefits of the town meeting in the greater concerns of our national life? The mechanism which we are here using is one adapted to permit many speakers in many distant audiences to be heard by all who care to listen and take part in a common discussion.

"In voicing the opinion that this mechanism is destined profoundly to affect our political and economic machinery, I intend to convey no thought or picture of a pure democracy, but only of a representative form of government in which all questions that would be helped by oral discussion can be so discussed without restraint from the physical limitations of the human voice or of distance. They might be discussions between widely separated groups on some matter of common concern or between a designated representative and his constituents. We have here the successful realization of a dream dating back to the pioneer days of Bell himself, namely, the production of a loud-speaking telephone which would reproduce the human voice in stentorian tones and in many places simultaneously.

ONLY DISTANT VISION LACKING

"We lack only direct distant vision to make this joint meeting one in very fact save only for the element of the personal proximity of those in attendance, and who among us is hardy enough to believe that this last limitation may not be removed within the lifetime of many of those now here?

"Fundamental and applied research are opening new doors daily in bewildering succession. When they open that last door which now prevents man from exercising at a distance all of his powers of personal intimate communication we will have another noteworthy meeting of this Institute.

"Tonight, however, we must be content with full powers of speech and hearing but with partially defective vision. So it comes about that you, Mr. Schuchardt, our vice-president in Chicago, and you, Mr. Rhodes, my vice-chairman, are each in a unique position, a position in which one of you is acting in place of the president at a meeting where the president himself is in attendance in his official capacity, and the other is acting similarly for the president in his capacity as presiding officer. Some day this may not be necessary, but for the moment we are really acting as the eyes of this great joint meeting and are transferring as best we can the functions of distant vision by means of human speech."

TECHNICAL POINTS EXPLAINED

The technical aspects of the loud-speaking telephone were discussed in a paper by I. W. Green of the American Telephone & Telegraph Company and J. P. Maxfield of the Western Electric Company, who stated that the amplifying apparatus used last night was powerful enough to reach an audience of seven hundred thousand persons and that the electric power used by the loud-speaking telephones would be sufficient to operate all of the fourteen million telephone instruments in the country.

A second paper by W. H. Martin and A. B. Clark, read in Chicago, described the problem involved in attaching the loud speaker to long-distance telephone circuits. Both papers were discussed simultaneously before two audiences by J. J. Carty, vice-president of the American Telephone & Telegraph Company, speaking in New York, and B. E. Sunny, chairman of the board of directors of the Illinois Bell Telephone Company, speaking in Chicago.

After the discussion of these two papers W. B. Potter of the General Electric Company presented his observations on electric railway practice in Europe. This paper included a comparison of American and European rolling stock. He also gave a comprehensive description of the various methods of locomotive drive used in Europe, illustrating them with numerous slides. M. Le Blanc, a visiting French railway engineer, discussed this paper.

Reports of the six technical sessions of the convention will be presented at considerable length in next week's issue of the ELECTRICAL WORLD.

Spring Convention of Institute at Pittsburgh

The spring convention committee of the American Institute of Electrical Engineers, in connection with the meetings and papers committee, has fixed the date of the Pittsburgh meeting as April 24-26. The headquarters will be at the William Penn Hotel. On the first day there will be afternoon and evening technical sessions, on the second day a technical session under the auspices of the protective-device committee in the morning and a visit to the Westinghouse plant at East Pittsburgh in the afternoon, and on the third day a morning program under the auspices of the electrochemical and

electrometallurgical committees and an afternoon session dealing with radio at which there will be papers presented on the applications of wireless to power transmission.

For the annual convention of the Institute, to be held at Swampscott, Mass., June 25-29, tentative plans are being formed by the committees in charge.

The Pacific Coast men have already prepared their program for the Del Monte convention on Sept. 25-28, as announced in the ELECTRICAL WORLD for Feb. 3, page 293.

House Pursues Subject of Radio Monopoly

As an outcome of the discussion by the House of Representatives of the alleged monopoly of radio transmission by four large companies (see ELECTRICAL WORLD for Feb. 10, page 350), Representative White of Maine has introduced a resolution calling for investigation by the Federal Trade Commission of ownership and control of patents for the manufacture of radio apparatus, contracts or agreements for the sale or use of such apparatus tending to restrict or to fix prices, and agreements tending to give exclusive rights or special privileges in transmission or reception of radio messages.

The resolution has been referred to the committee on merchant marine and fisheries, which is favorable to it, and it is expected that it will be adopted by the House. Concurrence by the Senate would not be necessary.

Federation Urges Leadership by Engineers

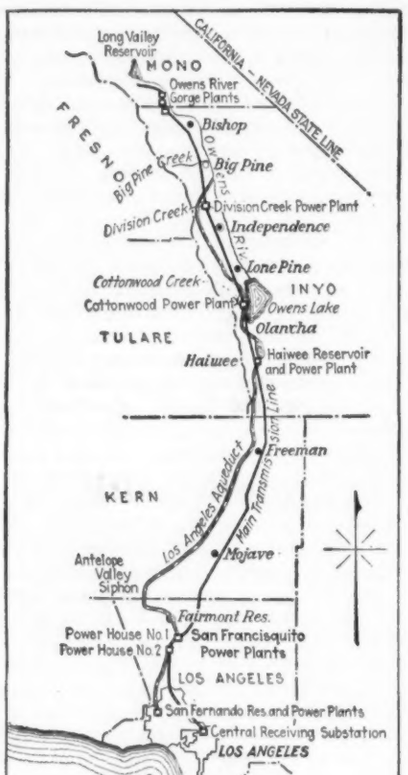
"For a century," declares the committee on industrial ideals appointed by the Federated American Engineering Societies, in a report recently submitted to the federation, "engineers have directed their energy toward the utilization of the physical forces and the materials of nature. The developments which they have brought about have created an epoch in human history. While these developments have been of inestimable benefit and modern society could not exist without them, they have introduced many public problems and social readjustments so closely related to the engineer's activities that it is increasingly evident he must assume an active part in their solution.

"Recognizing this growing need, the engineers of the country formed the Federated American Engineering Societies, primarily to place their knowledge and training at the public service on all public matters affecting engineering or affected by it. The Federated American Engineering Societies, therefore, speaking for the engineering profession, urges upon engineering colleges an increased attention to the social aspects of engineering activities and a broadening of their technical training in every way possible, to develop in engineering students the spirit of and a capacity for active leadership, not only in industry but in public affairs."

Prof. Joseph W. Roe, head of the department of industrial engineering at New York University, is the head of the committee on industrial ideals, of which the other members are Dean Cooley, Prof. C. F. Scott of Yale and J. C. Ralston of Spokane, Wash.

Outline Map of Los Angeles' Proposed System

The map below indicates the territory to be covered by the hydro-electric system planned by the city of Los Angeles. The ultimate output to be delivered to the city from these developments is put at 205,000 hp., 105,000 hp. coming



from San Francisquito plants Nos. 1 and 2 and 100,000 hp. from all other plants. Further details are covered in the following tabulation:

	Francisquito No. 1	Francisquito No. 2
Gross head, ft.	943	562
Maximum flow, sec.-ft.	1,000	1,000
Average flow, sec.-ft.	400	400
Output at switchboard (at 1,000 sec.-ft. flow), hp.	69,000	44,000
Generating units, number	6	3
Generating units, size hp.	12,500	18,500

Washington State Now Has Information Committee

Organization at Seattle of the Washington Committee on Public Utility Information has been announced, with E. H. Thomas, until recently publicity representative of the Puget Sound Power & Light Company, as director. The following utility companies are backing the new committee: Puget Sound Power & Light Company, Pacific Power & Light Company, Portland Railway, Light & Power Company, Grays Harbor Railway & Light Company, North Pacific Public Service Company, Olympia Light & Power Company, Stevens County Light & Power Company, and a number of other smaller companies.

In announcing its formation Mr. Thomas said:

"The purpose of the committee is to promote better relations between the utilities and their customers and to give the public such information as they may desire regarding the utilities and their organization and operation.

"Weekly bulletins to the press of the state will be one of the methods employed to give out information, but not the only one. We offer our services to interested patrons and citizens, and particularly to the newspapers, as an information bureau."

Another Indiana Utility Commission Bill

The latest bill to be introduced in the Indiana General Assembly to curtail the authority of the Public Service Commission would permit municipal corporations to establish utilities when privately owned utilities providing the same service already exist without asking the commission for permission. This bill does not mention the fixing of rates, leaving that to the commission. A bill introduced previously along the same lines permitted the municipalities to fix rates also without interference from the commission.

Underwood Seeks Action on Ford Proposals

With all the probabilities strongly against his success, Senator Underwood of Alabama, the Democratic leader of the Senate, is contending in the upper house that since Henry Ford's bid for Muscle Shoals was submitted as a result of a formal request from the government it should be accepted or rejected by this Congress. Business ethics, the Senator holds, demand that when bids are invited the bidders shall be told whether their proposals are accepted or rejected. He characterized the long-delayed action on the Ford offer as a cavalier way in which to treat any bidder.

Senator Underwood called attention to the fact that there no longer is any controversy about the completion of the Wilson Dam since each house has authorized the engineers to make the final contract for its completion. He pointed out that within three years at most a great electric plant will be ready for operation at Muscle Shoals, saying that the issue before Congress is whether it is to be operated by private effort or as a government institution.

The debate in the Senate was brought about by an amendment proposed by Senator Norris suggesting an appropriation of $2,000,000 for the installation of new machinery in Nitrate Plant No. 1, so that the plant could be used for experimental purposes. Senator Norris argued that such a proposal should not be objectionable to Mr. Ford since he

would have to conduct such experiments if his offer were accepted. The amendment was opposed on the ground that it would complicate the situation by additional expenditures, experimentation and contracts. The trend of the debate made it clear to Senator Norris that the amendment could not prevail, and he withdrew it.

Defenders of Water-Power Act Attack Ford Plan

Herbert Knox Smith, Commissioner of Corporations under Presidents Roosevelt and Taft, and Philip P. Wells, secretary of the National Committee for Defense of the Federal Water-Power Act, have launched a broadside attack upon the Ford Muscle Shoals offer in a letter and pamphlet sent to members of the Senate and House of Representatives.

The letter, written by Mr. Wells, summarizes the arguments against the legislation favored by Mr. Ford's supporters as follows:

"The real vice of this scheme is not in the present money loss. Its real vice is that it smashes straight through the vital principles of the federal water-power act for the protection of the public.

"(1) It is a grant for one hundred years.

"(2) It provides for no rental payments whatsoever for the use of the site and only an absurdly small rental for the use of the works built with government money.

"(3) There is no provision whatsoever to prevent the making of excessive profits on the Ford company's actual investment nor to require any transfer of such excess to the public.

"(4) There is no regulation whatsoever of the distribution or use of the power.

"(5) There is no provision that it shall be used for public service.

"(6) The Ford company is not required in any way to contribute to the cost of storage reservoirs hereafter built upstream. Such reservoirs would enormously increase the value of the Ford company's site, and the government is now making a survey for such storage development."

With Mr. Wells' letter is inclosed a pamphlet by Mr. Smith bearing the title "Preserve the Federal Water-Power Act." In this pamphlet Mr. Smith does not mince his words. "Flagrant violation," "extraordinary special privilege" and "national insanity" are among the terms he applies to the Ford proposal.

Electric Heat Exhibit in Edison Showrooms

The second of the series of special electrical exhibits which the New York Edison Company has scheduled for its Irving Place showroom will show the domestic, industrial and commercial uses of electric heat and will be held during the week of Feb. 19-24. Twenty-one manufacturers will exhibit.

Electrical Supply Jobbers Discuss Competition

The future of the electrical supply jobbers' business, the value of their association and a talk on federal income taxes were the chief features of the two-day session of the Central Division of the Electrical Supply Jobbers' Association held at the Hotel Sherman, Chicago, this week.

Discussing the future of the business, N. G. Harvey, Chicago, felt that the change throughout the country in central-station sentiment toward jobbers would help in solving many jobbing problems. With these cordial relationships, together with the increase of building, he thought that the supply business during 1923 would be on the up grade.

F. D. Vanwinkle, Cincinnati, cited figures which showed that more houses were wired in his territory during the past two years than in the previous thirty. With an operating jobbing expense in 1922 of 17 per cent, Mr. Vanwinkle failed to see how it was possible to reduce his expense any lower for two reasons, first, because each item of this expense had been cut to the bone and, second, because salaries and materials would be higher in 1923.

The subject of competition was warmly discussed by W. R. Herstein, W. W. Low, H. F. Thomas, C. J. Litscher and Harry Downing. The general sentiment was opposed to price cutting, although competition sometimes played havoc with legitimate profit. Regarding compensation of salesmen, W. W. Low, Chicago, thought that a percentage of profit would be more beneficial to both the jobber and his salesmen than one on sales volume.

P. Oblinger, Indianapolis, declared that the jobbing business was here to stay, but that with each house it would be a case of survival of the fittest.

O. E. L. A. New-Business Meeting

The new-business co-operations committee of the Ohio Electric Light Association will meet at the Deshler Hotel, Columbus, on Wednesday next, Feb. 21. Prof. H. B. Dates, Case School of Applied Science, will speak in the morning on "Public School Lighting," and Prof. F. C. Caldwell, Ohio State University, will lead a discussion on this subject.

Dr. M. Luckiesh is to present a paper on "Modern Lighting" during the afternoon session, which will be discussed by S. G. Hibben and J. B. Wilson. "Recent Progress in Rural Service" will be treated by D. L. Gaskill, secretary of the association.

Commonwealth Edison's Newest Station

Crawford Avenue Will Have Ultimate Rating of 400,000 Kw., if Not of 600,000 Kw.—Construction Begun and First Unit Will Probably Be Ready in Eighteen Months

FURTHER construction plans for its new South Crawford Avenue plant have been announced by the Commonwealth Edison Company of Chicago. The second generating unit of this 400,000-kw. station will have a rating of 50,000 kw. and will be manufactured by the Westinghouse Electric & Manufacturing Company. Like the 40,000-kw. Parsons unit, which was announced in the January 20 issue of the ELECTRICAL WORLD, this unit will have a high-and-low-pressure compound section. The third unit, not yet ordered, will be supplied by another American manufacturer.

Construction work on this site, on the east side of Crawford Avenue, extending south from West Thirty-third Street to the Drainage Canal, has been started, and the first generating unit will, it is expected, be in operation in August, 1924. Storage space for about 300,000 tons of coal is provided by the 72-acre plot.

With the station planned for ten units of from 40,000 kw. to 60,000 kw. each, the ultimate capacity will not be less than 400,000 kw. and, when finally completed, it may be around 600,000 kw. The main turbine hall will be 800 ft. long and 125 ft. wide. Five smokestacks in the completed station will extend 175 ft. above the boiler-room floor. They will be of steel and are to taper from the bottom to the top, with an inside diameter of 19 ft. Two rows of five boilers each will be connected to one stack. Since five boilers will provide steam for one unit, the total number of boilers in the entire plant will be fifty. These boilers are to operate at a steam pressure of 550 lb., giving a total steam temperature of 725 deg. F. Ample water facilities for condensing purposes will be obtained from the Drainage Canal, which comes from Lake Michigan.

This Crawford Avenue station will constitute the fourth great power-producing center of Chicago. To provide continuity of service the new station will be tied in by four 33,000-volt underground cables to the Calumet station, by two underground cables to Quarry and Fisk Streets and by two cables to the Northwest station. These tie lines will terminate at Crawford Avenue in an outdoor switching center.

The consulting engineers for the Crawford Avenue station are Sargent & Lundy, Chicago, while Merz & McLellan of London are acting in an advisory capacity on Unit No. 1. The engineering department of the Commonwealth Edison Company is handling the electrical features. Graham, Anderson, Probst & White are the architects.

Death of Röntgen

Famous Discoverer of X-Rays Dies at His Home in Munich in His Seventy-eighth Year

THE discoverer of the X-Rays, Wilhelm Konrad Röntgen, died at his home in Munich on Saturday, Feb. 10, at the age of seventy-seven. He was born in Lennep, in the Ruhr district of Germany.

The discovery of the X-rays dates back to 1895. Many before Röntgen, while discharging electricity through vacuum tubes or highly exhausted tubes in the study of the action of electricity on gas, had produced X-rays without becoming aware of their presence. In this kind of experiment Sir William Crookes had developed the Crookes tube, but he did not detect the fact that this tube produced rays which penetrated matter and made it possible to see through solids. This discovery was left for the German scientist. When he announced it the X-rays were looked on as some new manifestation of energy. It has since been shown that they differ from ordinary light only in wave length. Visible light is of the order of a fifty-thousandth part of an inch in wave length while the X-rays have to be described in millionth and billionth parts of an inch.

Dr. Röntgen was fifty years old when he made his discovery. He received his early education in Holland and then went to study at Zurich, where he took his doctor's degree in 1869. He was director of the Physical Institute at Wurzburg when he discovered the X-rays. In 1900 Columbia University awarded him the Barnard medal for the greatest discovery in science of the previous five years. In 1901 he received the Nobel prize for physics. He received the Rumford medal of the Royal Society in London in 1896, jointly with Philip Lenard, who had conducted researches in the same subject.

Brooklyn Edison Company Has Prosperous Year

The annual report of the Brooklyn Edison Company for the year ended Dec. 31, 1922, shows substantial increases in gross and net revenues over the previous year. The net income was $4,105,407, as compared with $2,772,420 the year before, and surplus for the year, after deducting dividends, contingency reserves and other charges, amounted to $972,364, against $255,-074.

A feature of the report was the increase in the holdings of stock by employees. The investment fund set up by the company in the interest of employees retains 8,795 shares of stock for the benefit of 2,757 employees, and in addition 454 employees hold individually 6,000 shares, making total holdings of 14,795 shares by employees, an increase of 300 per cent since 1916.

"The year was the most progressive in the company's history," President Sloan said in his statement. "During the year the company sold 381,232,300 kw.-hr., an increase of 55,467,782 kw.-hr. over the preceding year. New meters installed totaled 63,657, and power contracts for 60,000 hp., an excess of more than 50 per cent over the previous year, were secured. There were built and connected to the existing system 31 miles operating at 13,200 volts, 19 miles at 6,600 volts, and in addition 888 miles of distribution feeders and mains."

Hartford Offers New Heating and Lighting Rate

Another two-part rate has been established recently by the Hartford (Conn.) Electric Light Company in connection with residential service, the new schedule being optional and available only for private household use, for lighting and the usual small domestic appliances in conjunction with an electric range and large water or air heaters. All ranges, heaters, etc., used on this schedule are subject to the approval of the company as to size and types, and the customer is required to arrange wiring for one or more meters as directed by the company, the readings of all meters being added together for billing purposes. Customers using this schedule guarantee an annual payment for energy of not less than 300 kw.-hr. for each kilowatt of apparatus charged for in the flat-rate portion of the schedule.

The schedule is as follows: (1) Flat rate, payable monthly, with (a) $1.44 per year per 100 sq.ft. of floor area plus (b) $24 per year for the first 4 kw. (or any part) and $4 for each additional whole kilowatt of installed load of range and each kilowatt of large water or air heater (minimum kw.), plus (2) energy at 2 cents per kilowatt-hour. The rate carries the coal clause applying to the company's power rates.

Many Projects Before Power Board

Spawning Grounds for Fish Prevent Erection of Dams in Alaskan Streams—Licenses Granted in National Forests—Damage Clauses Outside Commission's Jurisdiction

NO LICENSES are to be granted by the Federal Power Commission for power projects on Anan Creek and the Kenai River in Alaska because it is held that high dams in these streams would result in damages to the fish industry entirely out of proportion to the value of the streams as power producers. Preliminary permits subject to the approval of the Bureau of Fisheries had been granted. Frank L. Bellain of Seward was the applicant for the Kenai River site, which was to have been used to furnish power for pulp and paper manufacture, and the Anan permit had been issued to the Alaskan Mine & Development Company, a Guggenheim interest. In each ease, the commission believes, the applicants will be able to find equally desirable sites where dams would not interfere with spawning grounds.

A preliminary permit has been authorized, in accordance with the application of Frank I. Reed of Anchorage, Alaska, covering a power project on the Eklutna River, near Anchorage.

Favorable action was taken on the application of the Mokelumne River Power & Water Company of San Francisco for a preliminary permit covering a combined power and irrigation project on the South and Middle Forks of the Mokelumne River and the North Fork of the Calaveras River.

An extension of one year in the time limit of the preliminary permit of the Lower Niagara River Power & Water Supply Company of New York has been granted by the commission. The company received a preliminary permit on March 3, 1921, for a period of two years.

The preliminary permit of Mushen & Cronemiller of Lakeview, Ore., has been extended one year from May 25, 1923.

The preliminary permit of the Louisiana Gravity Canal Company of Alexandria, La., which was issued on Jan. 4, 1922, for a period of fifteen months, has been extended for a period of twenty-one months.

The preliminary permit issued R. G. McDonald of Williams, Cal., on June 15, 1922, covering a project on Convict Creek has been revoked on the ground that he has failed to carry out the engineering investigations and the stream gaging required.

A license covering the Narrows unit of the Ouachita River project of the Caddo River Power & Irrigation Compang has been issued. The company, which has its domicile at Little Rock, Ark., holds a license covering two more important sites on the Ouachita, but has decided to begin with the smaller projects at the Narrows site, 11 miles below the others.

Licenses in National Forests

Two transmission lines owned by the Summit Power Company of Denver have been licensed by the commission. The lines cross the Leadville National Forest. A license was authorized for the Nevada-California Power Company of Riverside, Cal., covering a transmission line in the Inyo National Forest, which will connect the company's Bishop Creek plant to the trunk line of the Southern Sierras Power Company. A license also was authorized covering a transmission line in the Whitman National Forest, to be used by the Beaver Gold Mining Company of Portland, Ore. A license was also issued to A. E. Humphreys of Denver covering a 15-hp. project in the Rio

Grande National Forest. Permission was given the Virginia-Western Power Company to overflow a few acres of the Natural Bridge National Forest at Balcony Falls, on the James River, Va.

The commission has authorized an amendment to the license issued the Utah Power & Light Company for its Soda Point project on the Bear River in Idaho which will permit it to relocate its dam and power house 1,200 ft. upstream to avoid leaking bedrock.

Formal protests have been filed with the commission by the Tennessee municipalities of Bristol and Bluff City and by the County of Sullivan against the application of the Holston River Power Company, covering three sites on the Holston River. The protest discloses that public development of that stream is in contemplation.

In response to a letter from Governor Hunt of Arizona urging prompt action on the Girand application for a license at Diamond Creek on the Colorado River, the commission has replied that action in the matter will be withheld pending the disposition to be made of the Colorado River compact.

The development of hydro-electric power in the vicinity of Louisville has been further complicated by the entry upon the scene of Indianapolis interests, which have filed a declaration of intention covering power development on the Cumberland River.

Damages Outside Commission's Scope

The Salt River Valley Water Users' Association has been given to understand by the Federal Power Commission that it will not hold up development on grounds such as have been put forward by that association against the application of F. G. Baum for a preliminary permit covering a project on Black River. Were the commission to accede to the wishes of the Water Users' Association, it is held, the development of 6,000 square miles in the drainage area above the Roosevelt Dam would be stopped. Neither will the commission insert conditions as to damages. The whole question of damages, it is held, is outside its jurisdiction.

The board of regents of the University of Minnesota has formally petitioned the commission to issue no license covering the High Dam in the Mississippi unless it contain a provision that the university is to receive the revenue accruing from 15 per cent of the power sold and be safeguarded in the use of whatever volume of water it may require for hydraulic experiments.

Representatives of the States of Washington, Idaho and Montana, and of the Montana Power Company, have been invited by the executive secretary of the commission to appear before him on March 15 in connection with the Flathead Lake development proposed by the Rocky Mountain Power Company. The principal question involved is whether or not the power company should make full development of the storage or whether the Washington State authorities should be allowed to develop a part of it.

Big Program in Ohio

Electric Utilities Planning to Spend About $75,000,000 in the Next Three or Four Years

A TENTATIVE program involving the expenditure in Ohio of more than $75,000,000 in the next three or four years for additional facilities in the generation and distribution of electricity is now under way. This program, part of which will be actually carried out this year, involves the establishment of a state superpower zone system that will link together most of the great central stations. Virtually every large city in the state will be affected. Lack of water for condensation purposes, particularly in the central part of the state, has been a large factor in leading to the superpower project.

Before the end of 1923 physical interconnection between the properties of the Cleveland Electric Illuminating Company, the Northern Ohio Traction & Light Company and the American Gas & Electric Company, operating through its subsidiary, the Ohio Power Company, will, it is thought, become an accomplished fact. Actual construction on this project is now well under way, as is also another interconnection that will link with this power zone the properties of the Ohio Public Service Company, already tied in through the Lake Shore Electric Railway Company with the generating plants of the Toledo Edison Company. This means that by fall a superpower system for the entire eastern half of the state and that whole portion lying along Lake Erie from Cleveland to Toledo will have been built.

Southern Ohio Companies to Come In

In addition to this, engineers have begun calculations to determine how the properties of the Union Gas & Electric Company at Cincinnati may be "hooked up" to carry current up the state as far as Columbus. In this scheme is involved the problem of linking in the Dayton Power & Light Company, which serves many towns in the southwestern part of the state, and the Consolidated Light, Heat & Power Company of Huntington, W. Va., which serves communities in the southeastern part of Ohio as well as in West Virginia.

The superpower system for Ohio involves the expenditure not only of many millions for new generating stations but also of many additional millions for high-tension transmission lines. The maximum capacity of these lines for the present will be 132,000 volts, but before the entire development is completed this maximum will probably be increased in some instances to 220,000 volts.

Construction work under way this year in the building of new generating plants at Cleveland, Zanesville, Steubenville, Windsor and Beach Bottom, W. Va., together with high-tension transmission lines, involves a new capital investment of approximately $40,000,000 and means that the customers on the lines of the Cleveland Electric Illuminating Company, the Northern Ohio Traction & Light Company, the Pennsylvania-Ohio Electric Company, the Ohio Public Service Company and the American Gas & Electric Company, through its subsidiary, the Ohio Power Company, will be assured of adequate and uninterrupted service.

New Transmission Line from Cleveland to Akron

Contract for a 132,000-volt transmission line to tie in the Cleveland Electric Illuminating Company with the Northern Ohio Traction & Light Company at Akron, Ohio, has been awarded. This undertaking involves an expenditure of approximately $750,000. The Cleveland company will construct the line as far as the southern boundary of Cuyahoga County. From that point to the South Akron substation the Northern Ohio will build the line. An addition is to be built to this substation which will include new transformers. At this point the high-tension line from Windsor, W. Va., ties in, giving the Ohio utility three sources of supply. The power demand upon the Northern Ohio Traction & Light Company is now almost up to the capacity of the Gorge plant and the supply from Windsor; but this new supply from Cleveland is bringing 25,000 kw. and will aid future development of Akron as well as provide a strong reserve for the needs of the future.

Steel towers 86 ft. high will be designed to provide for two circuits, although only one will be completed at the present time. The Akron load demand in 1915 was 16,500 kw. In 1922 it had risen to 45,000 kw., with an output of 232,000,000 kw.-hr.

Nation-Wide Farm Radio Service Completed

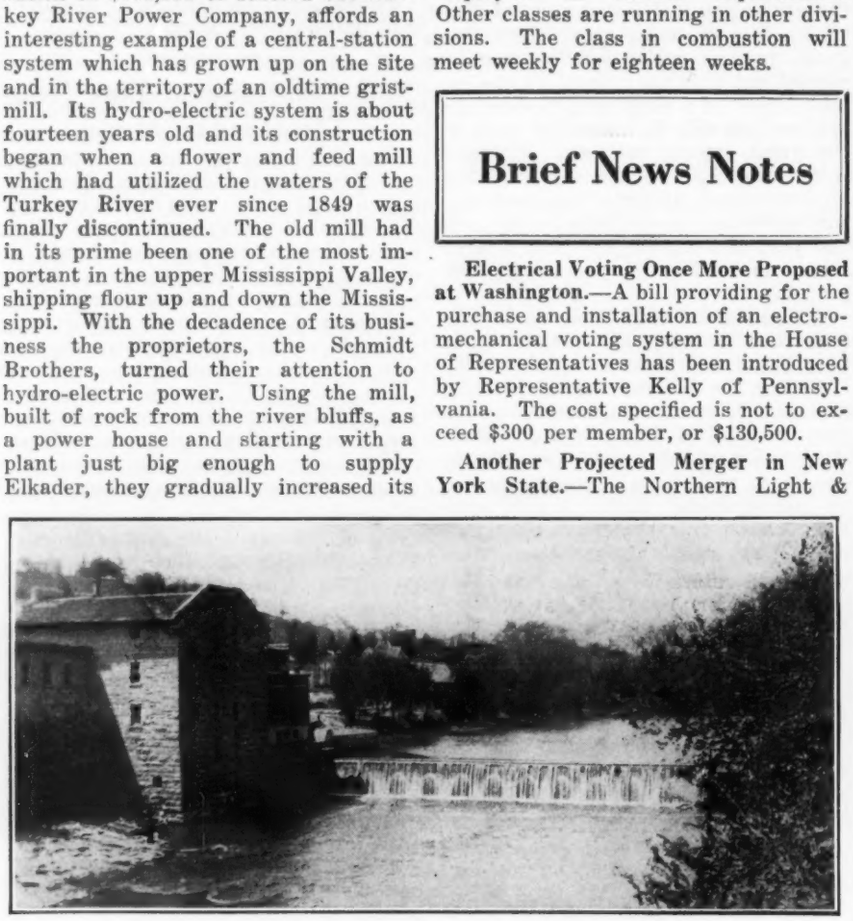
Completion of a radio communication service covering the entire United States has just been announced by the Department of Agriculture. The service includes market reports, weather information and crop data and insurance against losses due to unexpected storms. The service employs four high-power radio-telegraph stations of the Navy Department, five radio-telegraph and one radio-telephone installation of the Post Office Department and seventy-eight radio-telephone stations belonging to agricultural colleges, electric light and power companies, newspapers and other owners.

It is now possible, it is declared, to communicate with farmers in every section of the country, warn them of the approach of storms, advise them of the proper time to move produce so as to avoid flooding the market, and at all times keep them posted on agricultural topics of interest long before the news could reach them in the ways through which it has hitherto come.

From Mill to Power House

How a Hydro-Electric System Has Superseded Oldtime Hydraulic Plant in Iowa

THE People's Electric Service Company of Elkader, Iowa, which has just been incorporated with a capitalization of $750,000 to succeed the Turkey River Power Company, affords an interesting example of a central-station system which has grown up on the site and in the territory of an oldtime grist-mill. Its hydro-electric system is about fourteen years old and its construction began when a flower and feed mill which had utilized the waters of the Turkey River ever since 1849 was finally discontinued. The old mill had in its prime been one of the most important in the upper Mississippi Valley, shipping flour up and down the Mississippi. With the decadence of its business the proprietors, the Schmidt Brothers, turned their attention to hydro-electric power. Using the mill, built of rock from the river bluffs, as a power house and starting with a plant just big enough to supply Elkader, they gradually increased its capacity and extended their lines until at present there are thirty or more towns on the company's circuit and its high-tension lines run into four Iowa counties. A modern concrete dam has supplanted the old rock and log structure, and the interior of the mill is now being remodeled, the part formerly used for a flour storeroom being made over into a workroom, a storeroom for electrical supplies and an office and display room for fixtures and accessories. The company is now planning to reclaim another millsite on the Turkey River, south of Elkader, where a big four-story mill still stands, though it has long since ceased to grind and the dam has for the most part disappeared.



IOWA CENTRAL-STATION PLANT INSTALLED IN OLD MILL

Oklahoma Operators Studying Combustion

A class in the combustion of fuel has been started by the city division of the Oklahoma Gas & Electric Company. L. C. Lichty, professor of mechanical engineering, University of Oklahoma, is conducting the course, which was worked out by J. F. Owens, vice-president and general manager; E. E. Hunter, superintendent of power plants, and W. J. Brown, chief engineer. The company bears half the expense and thus far forty-five men have enrolled. This class has been organized in fulfillment of the company's policy of establishing classes for its employees in various departments. Other classes are running in other divisions. The class in combustion will meet weekly for eighteen weeks.

Brief News Notes

Electrical Voting Once More Proposed at Washington.—A bill providing for the purchase and installation of an electro-mechanical voting system in the House of Representatives has been introduced by Representative Kelly of Pennsylvania. The cost specified is not to exceed $300 per member, or $130,500.

Another Projected Merger in New York State.—The Northern Light & Power Company has applied to the New York Public Service Commission for permission to acquire all the capital stock of the Malone Light & Power Company and to merge the two companies.

East Tennessee County May Build a Million-Dollar Hydro-Electric Plant.—A bill introduced in the Tennessee Legislature authorizes an expenditure of $1,000,000 by Sullivan County, Tenn., for the construction of a hydro-electric plant. The bill also authorizes the county to purchase water-power sites and build dams along the Holston River. It is thought the bill will pass.

Federal Ownership of All Wire and Wireless Lines Proposed.—A bill proposing government ownership and control through the Post Office Department of all electrical means for the transmission of intelligence for hire has been introduced in the House by Representative Sinclair, Republican, of North Dakota. Only farmers' telephone lines and amateur radio operators would be exempted.

Radio Connection from Berlin to Budapest.—Early in January radio-telegraphic connection by means of the Siemens "radional" system was begun between Berlin and Budapest. This new system allows the hourly dispatch of from 150 to 200 telegrams. The messages are sent in the ordinary alphabet and interception is almost impossible. Results thus far have been encouraging.

Another Iowa Utility Purchase.—The Creston Electric Light Company has purchased the Lorimor Light & Power Company. Necessary papers are being prepared for the consolidation of the Creston company with the Southern Iowa Utilities Company of Centerville. Creston has now been connected with Centerville through the continuation of a 33,000-volt line from Mount Ayr.

General Electric Bonuses.—The General Electric Company has just paid approximately $1,100,000 in bonds as supplementary compensation to the employees of its various plants who have been with the company for five years or more. This sum represents 5 per cent of the earnings of these employees for the six months' period ended Dec. 31. Of the total sum the Schenectady works received approximately $400,000.

Licensing Bill in New Jersey Senate.—An act enabling municipalities to license persons, firms or corporations engaged in the business of electrical contracting for the installation of interior wires or apparatus for electric light, heat or power purposes has been introduced into the Senate of New Jersey. It aims to "fix responsibility upon the electrical contractor for the safe installation of interior electrical work."

Central Illinois Public Service Company Grows.—The number of communities served directly by the Central Illinois Public Service Company has been increased to a total of 195 by the purchase of the properties owned by the Abbott Light & Power Company, operated from Petersburg, Ill. New communities included in the Abbott group that are served directly are Petersburg, Mason City, Tallula, Pleasant Plains and Ashland. Energy is wholesaled to eight other towns.

Portland (Ore.) Installing Automatic Telephones.—The Pacific Telephone & Telegraph Company of Portland, Ore., has just cut over about twelve thousand telephones, involving three exchanges, from the manual to the automatic system. The success with which this was done is evident by the fact that the actual work of the cut-over began at 11:30 p.m. on a Saturday night and soon after midnight subscribers were getting service over the automatic system.

International Chamber of Commerce to Meet in Rome.—The second general meeting of the International Chamber of Commerce will be held at Rome on March 18 to 24. Four group sessions and two general sessions will discuss matters of finance, an equal number of sessions will deal with industry and trade, and two group sessions and two general sessions will take up transportation problems. American delegates

sailed on Feb. 10 and will cruise the Mediterranean, visiting Palestine.

Indianapolis Competition to Be Fought in Courts.—The Indiana Public Service Commission has denied the petitions of the Merchants' Heat & Light Company and the Indianapolis Light & Heat Company, both of Indianapolis, for a rehearing of the case in which the commission granted the Terre Haute, Indianapolis & Eastern Traction Company permission to construct transmission lines in Indianapolis and thus become a competitor of the other two companies. Court action is now sought by the protesting utilities.

A National Museum of Engineering.—A joint committee on a National Museum of Engineering and Industry appointed by the four big engineering societies is formulating in co-operation with the National Museum of the Smithsonian Institution at Washington a plan for a great museum similar in character to the South Kensington Museum at London, the Conservatoire des Arts et Métiers at Paris and the Deutsches Museum at Munich, but more comprehensive in scope. This plan contemplates a central institution with local branches in different sections of the country. Edward D. Adams and Charles L. Clarke are the representatives of the A. I. E. E. on the committee.

Steel Company to Buy Energy from Utility.—The Commonwealth Steel Company, Granite City, Ill., has contracted for electrical power from the Madison County Light & Power Company, which is distributing energy from the Union Electric Light & Power Company of St. Louis. The total load will be 3,470 hp. and service will begin March 1. The decision to purchase central-station power was reached after a thorough analysis had shown it to be more economical than the production of power in the present plant. The Commonwealth Steel Company has one of the five large steel foundries which make the St. Louis industrial district the largest open-hearth-steel foundry center in the world.

Iowa College to Train Metermen in March.—Plans have been laid for the fifth annual course for electric metermen, to be held at the Iowa State College, at Ames, from March 12 to 16, 1923. The course on alternating-current meters is divided into four sections, depending upon the standing and previous experience of the metermen. One of these courses will be designed especially for meter superintendents and managers, and such topics as the effect of phase angle and ratio upon correct registration, the testing and care of standards and the metering of farm lines will be treated. A direct-current-meter course of instruction will consider the operation of the commutator and mercury-type meters and the standards used for direct-current testing. Classes comprising groups of six or eight men will be held from 8:30 a.m. until 4 p.m., and the evenings will be devoted to a discussion of the day's work. No tuition fee is to be charged.

Interstate Merger Completed.—The seven Indiana utilities whose consolidation with the Interstate Public Service Company has been finally approved by the Indiana Public Service Commission were valued by the commission as follows: Hydro-Electric Light & Power Company, Connersville, $1,132,212; Hawks Electric Company, Goshen, $1,124,903; Middlebury Electric Company, $18,953; Winona Electric Light & Water Company, $516,436; Electrical Transmission Company of Northern Indiana, $55,863; Southern Indiana Power Company, Williams, $1,382,672; Indianapolis & Louisville Railway Company, $1,840,000. The commission also allowed the Interstate to issue $3,100,000 securities to take the place of $3,139,950 in securities now out against the properties and in place of $1,808,156 of bills payable against one of the companies. The valuation figures submitted by the company were accepted by the commission.

Worcester Co-operative Course Successful.—About a year and a half ago the Worcester (Mass.) Polytechnic Institute put into effect a co-operative arrangement whereby students electing to do so at the end of the junior year might enter into fifteen months' engineering experience under commercial conditions, returning to the institute for their senior year's work at the end of their field service. While the plan is still too new for the publication of detailed results, Prof. H. B. Smith, director of the department of electrical engineering, states that the evidences of experience from the standpoints of the operating companies, the students and the institute are alike entirely satisfactory. Nine men are now at work in the senior class who have returned from their fifteen months' outside work and eleven men from last year's junior class are now in industry and are expected to return next September. It is probable that a larger number will go out from the present junior class into industrial work next June.

Starting Appraisal.—By order of the state utilities commission the Tennessee Electric Power Company is starting an appraisal of its entire system, which includes the physical properties of the former Tennessee Power Company, the Chattanooga Railway & Light Company and the Chattanooga & Tennessee River Power Company, which were merged into the Tennessee Electric Power Company last October. Among the physical properties of the Tennessee Electric Power Company are the 50,000-hp. hydro-electric plant at Hales Bar on the Tennessee River, two hydro plants of 45,000 hp. rating on the Ocoee River, a 20,000-hp. steam plant at Parksville and a 4,000-hp. steam plant at Chattanooga. The company also owns about 511 miles of high-tension lines connecting the above plants and extending over the state. Railway property is owned in Chattanooga. Tie connections exist with the Aluminum Company of America, with the Georgia Railway & Power Company and through the latter with the Alabama Power Company.

Associations and Societies

Ohio Electric Light Association.—The new-business co-operations committee of this association will meet at Columbus on Wednesday of net week, Feb. 21.

American Institute of Mining and Metallurgical Engineers.—In connection with the four-day meeting of this society in New York City next week there will be a banquet at the Waldorf-Astoria on Wednesday evening, at which the Italian Ambassador, Gelasio Gaetani, will speak.

Hartness Voices National Interests of the Engineer.—Speaking before the Pittsfield (Mass.) Section of the American Institute of Electrical Engineers at the annual banquet Feb. 2, former Governor James S. Hartness of Vermont emphasized the importance of a closer study of economics and public affairs by engineers of all branches of the profession and pointed out the opportunities before technical men in the education of the public to a better comprehension of the problems of industry and economics. W. P. White was toastmaster and two hundred attended.

Coming Meetings of Electrical and Other Technical Societies

[A complete directory of electrical associations is published in the first issue of each volume. See Jan. 6 issue, page 78, for latest list.]

American Institute of Mining and Metallurgical Engineers—New York, Feb. 19-21.

Wisconsin Engineering Society—Feb. 22-24. L. S. Smith, College of Engineering, Madison.

American Physical Society—New York, Feb. 24; Washington, April 21. D. C. Miller, Case School of Applied Science, Cleveland.

Pennsylvania State Association of Electrical Contractors and Dealers—Lancaster, Feb. 28. M. G. Sellers, 1518 Sansom St., Philadelphia.

Oklahoma Utilities Association—Oklahoma City, March 12-14. O. D. Hall, 1106 First National Bank Bldg., Oklahoma City.

Southwestern Division, N. E. L. A.—Oklahoma City, March 14-16. S. J. Ballinger, San Antonio Public Service Co., San Antonio, Tex.

Illinois State Electric Association—Chicago, March 14-15. R. V. Prather, 305 Mine Workers' Bldg., Springfield, Ill.

Wisconsin Utilities Association—Milwaukee, March 22-23. John N. Cadby, 445 Washington Bldg., Madison.

Tri-State Water and Light Association—Birmingham, April 17-20. W. F. Steiglitz, Columbia, S. C.

American Institute of Electrical Engineers—Spring convention, Pittsburgh, April 24-26; annual convention, Swampscott, Mass., June 25-29; Pacific Coast convention, Del Monte, Cal., Sept. 25-28.

American Electrochemical Society—New York, May 3-5. Colin G. Fink, Columbia University, New York.

Southwestern Public Service Association—Fort Worth, Tex., May 15-17. E. N. Wills, 403 Slaughter Bldg., Dallas, Tex.

Electrical Supply Jobbers' Association—executive committee and general meeting, Hot Springs, Va., May 21-25. Franklin Overbagh, 411 S. Clinton St., Chicago.

American Society of Mechanical Engineers—Montreal, May 28-31. C. W. Rice, 29 West 39th St., New York.

National Electric Light Association—New York, June 4-8. M. H. Aylesworth, 29 West 39th St., New York.

Electric Power Club—Hot Springs, Va., June 11-14. S. N. Clarkson, Kirby Bldg., Cleveland.

Pacific Coast Electrical Association—San Francisco, June 19-22. S. H. Taylor, 527 Rialto Bldg., San Francisco.

Recent Court Decisions

Damages from Overflow Due to Increasing Height of Dam.—Grants of privileges to maintain dams over watercourses are to be read and construed in the light of the times and circumstances under which they are granted. So stating, the Kansas City Court of Appeals, in Cambest vs. McComas Hydro-Electric Company, sustained a verdict for the plaintiff, an abutting landowner, for damages due to the overflowing of his land through the raising of the height of a dam in the Platte River from 8 ft. to 15½ ft. The action of the company in raising the dam under a provision of an act of 1845 was found unwarranted in equity, and an assertion of the defendant that the abatement of the dam would cause loss to it out of proportion to the damage sustained by the landowner through its maintenance was declared not to be a valid defense. (245 S.W. 598).*

Power to Limit Security Issues.—The power of the Michigan Public Utilities Commission to fix the amount of the issue of stock and bonds and to fix it at the value of the property has been upheld by the Michigan Supreme Court in Hillsdale Light & Fuel Company vs. Commission. It was contended that if the commission finds that the property is reasonably required for the purposes of the utility and the funds are to be used for a lawful purpose, it is beyond the power of the commission to limit the amount of stock or bonds to be issued and that this question must be left to the judgment of the governing board of directors of the corporation. The court held that the purpose of the act involved was to prevent the overcapitalization of public utilities and that the amount of capital stock and bonds should correlate with the amount and value of the company's property. (189 N. W. 893.)

Burden on Dependent to Establish Basis for Measurement of Compensation.—To justify an award to a dependent widow or children, under the terms of the workmen's compensation law of Minnesota, of any amount in excess of the minimum there allowed, the claimant has the burden to supply by competent evidence the basis for the measurement thereof as limited by that statute. So holding, the Supreme Court of Minnesota, in Kreidler vs. Mahnomen Electric Light & Power Service Company, decreed that the plaintiff, whose husband, an electrician earning 80 cents an hour, was not regularly employed by the defendant but was fatally injured while temporarily working for the company, was entitled only to the minimum compensation fixed by the statute ($6.50 a week), the evidence failing to establish that the man ever continued even a week in the service of the defendant at one time. The contention that he worked as a contractor and not as an employee was, however, overruled. (191 N. W. 277.)

Power Company Suable in County in Which It Overflowed Land by Dam in Another County.—In Price vs. Ketchum and Georgia-Alabama Power Company suit was brought for damages to land caused by the overflow of a dam belonging to the power company, to which Ketchum, who, it was alleged, had failed to carry out an agreement with Price regarding the purchase of timber on the land in question, had granted permission to back water and overflow the tract. This flooding had, plaintiff contended, destroyed the timber, to which he still claimed title. The Court of Appeals of Georgia has reversed a judgment dismissing the action, this action having been based in part on the contention that the case could not be tried in the county where the damage was done inasmuch as the dam was in another county. The finding also holds that a provision of the deed regarding overflow of the land by a third party did not liquidate damages so as to prevent action. (115 S. E. 32.)

Duty of Companies to Maintain Proper Insulation on Transmission Wires.—Premising that it is the duty of a corporation that maintains and controls wires charged with electricity in a place where it is likely that persons will come in contact therewith to use reasonable care to maintain proper insulation, and that the test of liability to a particular person is whether injury to him ought reasonably to have been anticipated, the Court of Errors and Appeals of New Jersey affirmed a verdict for the plaintiff in McGinnis vs. Delaware, Lackawanna & Western Railroad Company. In this case the defendant corporation maintained a wire across a public highway 18 ft. or 20 ft. above the surface of the street. A workman driving piling in the street came in contact with the wire and was killed. Whether or not the defendant's wire was maintained by legislative authority and whether or not the work upon which decedent was engaged was done under a city permit did not appear. The court held that the jury might infer negligence from evidence tending to show want of reasonable care in the insulation of the wire; that the mere fact that defendant's wire was strung 18 ft. or 20 ft. above the surface of the street did not relieve it from liability, since from the appearance of the pile driver and the place, progress and duration of the work it was open to the jury to find that the defendant should have foreseen the danger and anticipated injury to the decedent; that the fact that the work in the street upon which decedent was engaged was being done without a permit from the city would not defeat recovery, since the absence of a permit did not contribute to the injury and there was nothing to show that the work unreasonably interfered with the rights of the defendant or others in the street, and that the fact that decedent worked in close proximity to the wire could not be said as a matter of law to be negligence barring recovery, since the evidence tended to show that the wire was apparently safe and that decedent was without knowledge of its dangerous character. (119 At. 163.)

*The left-hand numbers refer to the volume and the right-hand numbers to the page of the National Reporter System.

Commission Rulings

That There Is Only One Customer Does Not Deprive a Public Service of Its Nature.—In a complaint asking that the tariff schedule of the Carlisle Light, Heat & Power Company covering rates for furnishing live steam for industrial heating be stricken from the files of the Public Service Commission of Pennsylvania, on the ground that the complainant was in fact the only user of live steam, and that respondent in the particular service was not functioning as a public utility, the commission dissented from the latter assertion and dismissed the complaint.

Idaho Commission on Expense of "Attaching Business."—In arriving at a valuation of the property of the Pocatello Gas & Power Company for rate-fixing purposes, the Idaho Public Utilities Commission had this to say on the expense of getting new business as an element in "going value": "Under business development there is rightfully included the cost of attaching business. The record shows that there was expended the sum of $45,916.88 for the purpose of attaching business. The methods employed by the company in attaching business were somewhat peculiar, yet it was probably as good a method as any which could have been devised under all the circumstances then existing. It is not the province of the commission to criticise any reasonable method employed by the utility in attempting to attain the end sought. The evidence discloses that at such time something was necessary, and the company, acting upon its best judgment, has partially accomplished the purpose sought. The business of the company has not yet reached the stage where the value of the business developed justifies the allowance of the above amount. The evidence shows that this company has not as yet reached that point where it has been able to pay operating expenses, taxes and a reasonable return. However, the company is entitled to have included in its rate base a reasonable amount for the cost of business development. Under all the conditions presented in the case the sum of $10,000 is a reasonable allowance for business development, when considered in conjunction with the value of the business as a going concern, and the sum of $10,000 will be allowed with the going-concern value included therein."

Men of the Industry

Changes in Personnel
Accomplishments, Responsibilities, Honors, Appointments and Activities of Men Engaged in all Branches of the Electrical Industry

B. I. Budd President Northern Illinois Company

Britton I. Budd, elected president of the Public Service Company of Northern Illinois, as was announced in the Feb. 10 issue of the ELECTRICAL WORLD, has been associated with the transportation business ever since he left school, at which time he took a situation in the surveying department of a steam railroad in Ohio. In 1893,

B. I. BUDD

during the World's Fair at Chicago, Mr. Budd was associated with the Intramural Railway. With the incorporation of the Metropolitan Elevated he saw Chicago's future transportation plans take real form, and when actual operation of that line was commenced in May, 1895, he obtained a position as clerk in the storehouse. With the Metropolitan his rise was rapid, for he soon became storekeeper, then purchasing agent and finally general manager. When Mr. Hetzler, president of the Metropolitan, left in 1910 Mr. Budd was elected president.

In 1911 a consolidation of all the elevated lines in Chicago was brought about, and Mr. Budd was chosen president of the combined system. Besides being president of the Chicago Elevated Lines, he became president of the Chicago, North Shore & Milwaukee Railroad at the time of that line's reorganization in 1916. Mr. Budd will continue as president of both these organizations.

Joseph S. Lessig has been appointed local manager of the Winona Electric Light & Power Company at Warsaw, Ind., which was recently consolidated with the Interstate Public Service Company.

Henry H. Russell, for the past three years Southern district manager for the Edison Electrical Appliance Company, is now associated with Mitchell Vance, Inc., New York.

Theodore B. Parker, formerly assistant hydraulic engineer for the Utah Power & Light Company and later for the Electric Bond & Share Company, New York, has entered the hydraulic division of Stone & Webster, Boston.

Robert E. Barrett, well-known in New England hydro-electric circles, has been elected president of the Holyoke (Mass.) Water Power Company. Mr. Barrett was formerly on the engineering staff of the Turners Falls (Mass.) Power & Electric Company and for several years has been the active manager of the Holyoke company with the title of treasurer.

C. L. Law Receives New Appointment

Clarence L. Law, for many years manager of the bureau of illuminating engineering of the New York Edison Company, has recently been appointed to the post of assistant to the general commercial manager, Arthur Williams. Mr. Law has been associated with the company since 1906, when he entered its service as special inspector. A year later he was made special agent and in January, 1910, he was made manager of the bureau of illuminating engineering. Notwithstanding the demands of his office, Mr. Law has found time for great activity in the affairs of the various organizations of the electrical industry. He is now serving as chairman of the metropolitan New York company section of the National Electric Light Association. He served two years as vice-president of the Illuminating Engineering Society, for five years was its general secretary and is now serving as one of its directors.

A. E. Reynolds Goes to Springfield, Mo.

Albert E. Reynolds, who recently resigned as general manager of the United Traction Company, Albany, N. Y., and Hudson Valley Railway Company, Glens Falls, N. Y., subsequently announcing his association with E. N. Sanderson of Sanderson & Porter, president of the Federal Light & Traction Company, New York City, has been elected vice-president and general manager of the Springfield Gas & Electric Company and Springfield Traction Company of Springfield, Mo. This is one of the subsidiary companies of the Federal Light & Traction Company. He entered upon his new duties at the beginning of the month. He succeeds E. C. Deal, who resigned from the Springfield properties to become associated with the Electric Bond & Share Company of New York. Mr. Reynolds has had many years of experience in the utility field which amply qualify him for his new work.

J. M. Barry Manages Alabama Company's Southern Division

J. M. Barry, who since the spring of 1921 has been assistant chief engineer of the Alabama Power Company, has been promoted to the position of manager of the southern division of the company, with headquarters at Montgomery. With the acquisition of the Montgomery electric service system, the possibilities of future hydro-electric

J. M. BARRY

development on the Tallapoosa River and the opportunities for expansion in the southern part of the state, this division has probably the greatest possibilities of growth existing on the entire system. As manager of the division Mr. Barry will have charge of all physical properties, public relations, commercial activities and operating and maintenance in that section.

Immediately after graduation from college in 1910 Mr. Barry joined the Pacific Gas & Electric Company's underground department in Sacramento, Cal., where he stayed for two years, then becoming electrical engineer of the Northwestern Electric Company, Portland, Ore. From 1914 to 1917 he was chief of the San Francisco department of electricity, and during the next two years he was distribution engineer of the Great Western Power Company. In 1919 he became connected with the Alabama Power Company, where he had charge of the eastern division until 1921.

Jerome Blaisdell has resigned from the Depew & Lancaster Light, Power & Conduit Company at Lancaster, N. Y., and is now associated with the Central Michigan Light & Power Company at Alma, Mich.

W. H. Taylor Elected Vice-President of Georgia Company

W. H. Taylor, formerly executive assistant of the Georgia Railway & Power Company, has been elected a vice-president of that company. Mr. Taylor is a widely known public utility executive, having been for seven years president of the Omaha Gas Company. Prior to his connection with the Omaha company he was with the United Gas Improvement Company as engineer in

W. H. TAYLOR

charge of the gas and electrical properties on the main line out of Philadelphia. He had previously served with the Fulton County Gas & Electric Company, Gloversville, N. Y., for a period of three years, where he was also engaged in engineering work. Previous to his association with the Georgia Railway & Power Company he was stationed in Philadelphia as an executive on matters of appraisal. Mr. Taylor is a graduate of the Stevens Institute of Technology, Hoboken, N. J.

C. B. Merrick, formerly in the inspection department of the San Joaquin Light & Power Corporation, has been placed in charge of the range department of the Valley Electrical Supply Company of Fresno.

Joseph George Ramsden is now a director of the Ontario Power Company of Niagara Falls, replacing Fred R. Miller, deceased, and D. Carmichael is vice-president of the company, replacing I. B. Lucas, resigned.

Stanley Walton, for thirteen years a member of the commercial department of the Pacific Gas & Electric Company and until recently sales manager of the gas and electric departments, has resigned to become sales manager of the Bonestell Paper Company.

Thomas W. Wootton, formerly connected with the Hydro-Electric Department, government of Tasmania, and later with the General Electric Company, has resigned to accept a position with the engineering department of the Adirondack Power & Light Corporation, Schenectady, N. Y.

E. T. Fishwick, general sales manager, has been appointed vice-president of the Worthington Pump & Machinery Corporation, New York, succeeding Frank H. Jones, who resigned.

George W. Bernhard, formerly manager of the northwestern district of the Great Western Power Company and special agent at Sacramento, has been named district manager at Oakland.

Ernest Johnson, formerly connected with the Holmes Electric Company, Fayetteville, N. C., is now associated with the Westinghouse Electric & Manufacturing Company.

Jesse Huff, formerly of the United States Patent Office examining corps, has resigned to become associated with the patent department of the General Electric Company at Schenectady, N. Y.

A. J. Chapman, formerly sales manager of the Gainaday Electric Company, Boston, has been appointed assistant sales manager of Beaudette & Graham, distributors of electrical household appliances in the same city.

Ralph B. Coleman, formerly in charge of the Chicago office of the Moloney Electric Company and also with the Electric Machinery Company, Minneapolis, for five years, has joined the forces of the Shakstad Electric Company, Sioux Falls, S. D.

R. L. Bennett, formerly sales manager of the Crystal Washing Machine Company, Detroit, and sales and advertising manager of the Air-Way Electric Appliance Corporation, Toledo, has been appointed general sales manager of the Berthold Electrical Manufacturing Company, Chicago.

John Gribbel of Philadelphia has been elected a member of the board of directors of the Cities Service Company. Mr. Gribbel is owner of John J. Griffin & Company, president of the Royal Electrotype Company of Philadelphia and the Athens (Ga.) Gas & Fuel Company, and vice-president of the American Railways Company of Philadelphia and the American Meter Company of Delaware.

J. Fisher, electrical engineer and contractor, was elected president of the Denver Association of Electrical Contractors and Dealers at the annual election held by that organization on Jan. 23. E. A. Scott was chosen as vice-president and H. Alex. Hibbard, a Denver manufacturer's representative, as secretary and treasurer. The three officers are members of the advisory board of the Electrical Co-operative League in that city.

F. P. Cummings, efficiency engineer of the Alabama Power Company, has been transferred to the position of commercial manager, where he succeeds F. D. Mahoney, who has joined the West Penn Power Company, with headquarters in Pittsburgh, Pa. Previous to Jan. 1, 1920, Mr. Cummings was operating manager of the Alabama Power Company for some time. Several years ago he was with H. L. Doherty & Company and, among other offices, held the position of commercial manager in Joplin, Mo.

J. L. Longino Vice-President of Arkansas Company

J. L. Longino, who was formerly operating superintendent of the Arkansas Light & Power Company and has served as its secretary and treasurer since organization, has been made vice-president and general manager of the company. Mr. Longino was made manager about two years ago of the Pine Bluff Company, an associated public utility company, which operates the

J. L. LONGINO

street-railway, electrical and water services in Pine Bluff. He will continue to manage the Pine Bluff Company, but will be relieved of some details by L. B. West, the auditor. The secretaryship of the Arkansas Light & Power Company has been taken over by L. Garrett.

E. F. Stoughton has been transferred from the treasurer's office of the Stone & Webster organization to the Cape Breton (N. S.) Electric Company.

C. E. Brigham, who was associated with the National Radio Institute at Washington, D. C., for two years, and more recently with the Radio Testing Laboratories of the United States Navy, has been appointed research and designing engineer for C. Brandes, Inc., of New York City.

Obituary

Dr. W. French Smith, president of the Mexican Telephone & Telegraph Company, died at his home in Somerville, Mass., Feb. 1, at the age of sixty-eight. Dr. Smith was well known in the metallurgical field aside from his interest in the development of foreign telephone service.

John S. Connell, sales representative of the Frank H. Stewart Electric Company, Philadelphia, died at Elmira, N.Y., on Wednesday, Jan. 31, while making a business trip. Mr. Connell had been associated with the company since 1907 and for a period of several years had served on the board of directors of the company.

Manufacturing and Markets

Devoted to the Discussion of Business and Economic Problems of the Producer and Distributor, with Market Reports, Trade Activities, Foreign and Construction News

Two Letters on Distribution

A Jobber Writes that It Is Public Demand for Extravagant Service that Makes Our Distribution Too Costly—A Further Analysis

A RECENT editorial in the ELECTRICAL WORLD on distribution costs concluded with this statement:

> **"But the public demands relief. Will electrical men and other industries, we wonder, find ways to cut down their costs by co-operation among themselves, or will they wait until Congress is driven by public clamor to tackle the whole job with many ill-considered laws?"**

The following letter from a jobber in the West argues that the responsibility for reducing this cost lies more with the public than with industry—a not uncommon point of view.

Of the facts as cited in this jobber's letter, there can be no question. The point is: Can the matter safely be left to the public to correct, or must industry act in its own behalf? Also, how much does industry contribute in its turn to this condition? This thought is discussed in a letter of reply, further analyzing the issue and showing that the editorial and the jobber's thinking are really not at variance. But the man of the industry naturally thinks as a jobber, a manufacturer, and is apt to see his opportunity to influence in distribution costs restricted to the field of his present activities. Progress will only be made, however, when these men take hold to get the job done for the industry as well as for the public, no matter where the work must be performed.

To the Commercial Editor of the ELECTRICAL WORLD:

DEAR SIR: For some time I have been holding on my desk a reprint of an editorial published in the ELECTRICAL WORLD on Saturday, Nov. 25, 1922, entitled "Distribution—Who Will Cheapen It?" This editorial was, of course, written with the idea of constructive help, but I am wondering whether it does not hurt the electrical industry more than it helps. The last paragraph of your article asks a very pertinent question as to what will be done to cut down the cost to the consumer, but limits this solution more or less to the producer.

It is unfortunate for the electrical industry that electrical men are trying to establish ideas of merchandising that are so totally different from the methods used in merchandising other classes of merchandise used by the public. My particular point is that you bring out the fact that a labor-saving device costing the manufacturer $50 sells for $125. How about the pair of shoes that you happen to be wearing while you are reading this letter? It is my opinion that you will find the same discrepancy between the cost of manufacture and what you paid for the shoes, and the demand that you personally made for service has caused this wide discrepancy.

Recently I had the pleasure of visiting one of the largest certified milk-producing plants in this country, and the reason I am speaking of this is because it represents a commodity that is consumed every day and on which the distribution cost should be lower than it would be on any appliance such as the electrical industry has to offer. However, I found this concern was making a pretty fair profit on its investment, was delivering the milk via train and truck to a town 75 miles away, delivering it to the man who takes it to the door of the home, for 13 cents a quart. The householder pays 25 cents a quart for this milk. Of course, many of these householders would like to have that milk a little cheaper, but the demand is such that there is no trouble in getting 25 cents. The public has made that price by demanding that the milk be put up in fine glass bottles, thoroughly sterilized, with patent caps, delivered to the door of the home in nice, clean, well-kept wagons or automobiles, by men dressed in white uniforms, always spick and span; that the bills be collected at the end of the month, and that it shall have the many other things that go under the head of service.

I have no doubt that if the public in general were willing to go back to the time of my boyhood days, when the dairyman came to the back door with a great big can, measured out the milk in the cover of the can, and poured it into a bucket that my mother stood holding in the doorway, the milk could still be purchased at the same price that my mother paid for it, and that is about 5 cents a quart. Our family seemed to have thrived on that dreadful milk that was neither pasteurized sterilized or any other "ized," but since we are now all so afraid of the many bugs, germs and other things that might be in the milk, in the wagon or in the clothes of the driver, we must pay the price.

It may seem to you that it is a long step from milk to washing machines, but if you will stop a few of the many things demanded by the public in the way of service, there should be less difference between the bare cost of the merchandise and the selling price. The washing machine should or will last ten or fifteen years—the family cannot drink it up every day—which is another factor that must be taken into account in the final analysis of the retail price.

The only solution that I can think of is a general propaganda throughout the United States to train the public to realize that our ways of living today are all wrong—that we must go back thirty-five or forty years in our ideas and be satisfied with the conditions, conveniences and ideas of that time. If the public is going to keep on demanding what is considered "modern service," then that public must pay that bill—in other words, if one will drive the old, broken-down gray mare up to a decrepit-looking country store, knock the proprietor down and take away from him a washing machine without all the beautiful enamel and one that does not look like a baby grand piano, pay cash for it, and then not have to have a man sent out every thirty or sixty days to see whether it is oiled or not, I think your problem would be solved and the question in your editorial fully answered.

I do feel that it is a pity that the press and everybody connected with the electrical industry keep harping on the dreadful difference between the cost of production and the cost to the ultimate user, without a proper analysis of the other classes of merchandise. Very truly yours,

_____ _____,
Vice-president.

MY DEAR MR. JOBBER: I agree with you entirely that the present "spread" on electrical devices is no greater than on shoes or clothes or milk or a dozen other lines that we can tell off on our fingers. In fact, it is not so great. I'll go you one further and say that the profit which electrical dealers and jobbers are making on many commodities is too small, far smaller than is earned for like service in other industries. But it is not profit that we are talking about, it is cost, and the general agitation through the country today in opposition to the present costs of distribution applies to food products, clothing and general manufactures no less than to electrical commodities.

The retail price of $125 on the indefinite appliance costing $50 to manufacture, which was cited as an example, is too great. But it is too great not because the agencies of distribution are making too much profit, but because the system of distribution by which they are operating is too costly. The purpose of the editorial was to say just this, that distribution is costing too much, that people are beginning to realize it and are demanding redress, and that it is better for the men of the industries affected to recognize this and do something to correct the situation than to let it ride until Congress undertakes to reform it with laws.

You are undoubtedly right in saying that the American public is demanding today an extravagant scale of service. The reason that the quart of milk sold at wholesale at 13 cents costs 25 cents delivered is because the public is buying not just a quart of

milk but also sterilization, patent caps and delivery in glass bottles by mean in clean, white uniforms who arrive in well-kept automobiles. They are purchasing not just milk but milk plus de luxe delivery, and this is true in our modern habits of buying most of our family supplies and in our personal purchases.

This is the cause of a good part of the present cost of distribution, but not all. Another part of it is our present system, wherein the dealer demands like extravagance in the service from the wholesaler and the wholesaler demands like extravagance in service from the manufacturer. This extravagance is expressed in small orders, excess varieties, wasteful packing and a dozen different other sources of unnecessary expense which come readily to mind.

Undoubtedly the public has forced a sizable part of this exorbitant distribution cost, but the electrical industry cannot sit back and say, "Because of this we will do nothing." For, in the last analysis, the public has the power and can do something about it itself through legislation, and the thing that they do may be the wrong thing. Therefore the electrical industry and other industries involved in the problem will be compelled to look the situation squarely in the face and take upon themselves the responsibility for influencing toward cheaper distribution in both these directions. That is, they must improve the economics of their own operations in so far as is humanly possible, and they must show the public clearly how great an element in the cost of commodities the modern standards of extravagant service which this generation is demanding have become.

We cannot passively sit back and wait for the public to find this out. Somebody has got to make this clear to the people and help them to see just how much of the price of goods is service and how much is commodity. And it would be far better for electrical men to undertake this job for their own protection than merely to deplore the condition and do nothing. I feel, therefore, that the industry itself has got to find the answer to the problem and to satisfy the public. It can do this in two ways—by introducing economies to eliminate existing costs that are excessive and by explaining more clearly to the people just what it is that makes up the cost of a commodity. Frankly, I do not believe the fact that similar conditions exist in other industries justifies any manufacturer or any jobber ignoring wasteful practice which he may be contributing to the high cost of distribution in his own business. I am sure that you will agree with me. Very truly yours,

———, Commercial Editor.

High Cost of Inspection Inconsistency

Some Pertinent Facts on the Excessive Variety of Switches Forced Upon the Industry by Lack of Uniformity in the Methods of the Inspectors

BY T. J. KAUFFMAN
Treasurer and General Manager
Square D Company, Detroit

IF THE leaders of the electrical industry are earnest in their interest in the betterment of conditions now obtaining in the manufacture and distribution of electrical products, there is a worthy work for them to do in the reduction of the inconsistencies in inspection as it is practiced throughout the country. At the present time the requirements of the inspection authorities in different states and different cities vary so greatly that it places a costly burden on the manufacturer and the jobber of many devices that are used in the premises of the consumer and adds materially to the expense of an electrical installation.

No one who is not engaged in the manufacture or distribution of such a product can appreciate the effect of these conditions and the extent of the burden which it unnecessarily inflicts. The object is always the same, to reduce some hazard to life or property by giving extra protection against shock or fire. But the methods differ. The men who devise the methods have varying opinions and do not interpret either the requirements of the code or the local conditions alike. As a result there has grown up a great diversity of demands for special equipment, and the manufacturer who wishes to sell in these markets must prepare all their duplicating varieties and the jobber must stock them. It all wastes money.

Take the switch, for instance. There is a big variance of opinion among electrical inspectors here as to the application of the national electrical code. Atlantic City, N. J., requires that switches must have slate bases and will not permit the use of porcelain-base switches even for ordinary residence service. Porcelain-base switches prove satisfactory in all other localities as far as I am aware, even those localities adjoining Atlantic City; but they may not be used in Atlantic City. And so it goes.

There are throughout the large cities of the United States at least twelve different requirements, I am certain, for ordinary 30-amp. entrance switches of the inclosed safety type. If the manufacturer does not manufacture switches to meet all of these requirements, he is barred out of certain cities, and to the best of my knowledge no manufacturer does make a line of switches complete enough to meet all twelve requirements. For example, in the city of Buffalo a device is required which is not manufactured for any other city in the country that I know of. For a manufacturer to attempt volume production would be impossible. No one could take on the manufacture of this Buffalo device, because a plant organized for volume production could not handle the device to advantage.

Again, in some cities it is not permissible on three-wire grounded-neutral systems to use a switch with a blade or a fuse or both in the neutral. In other cities, however, three-pole switches with three blades and two fuses are required even though they are not required by the National Electrical Code.

In one city in Michigan the cover of an inclosed-switch box must be so hinged that it will not break a sign receptacle when the sign receptacle is placed at the bottom of the switch, used as a fuse block, even though the use of a sign receptacle in this manner is a direct violation of the code. In other cities they will not permit the use of an inclosed externally operated switch unless it has an interior locking-off device. Other cities require that the locking-off device must be on the exterior of the switch so that it is plainly evident to the user when the switch is locked off. Some cities specify special solder lugs on inclosed externally operated switches as small as 30 amp. in size.

DISREGARD CODE AND LABOR

Some of these requirements are due to the ideas of those in charge of meter installations for the utilities. In other cases they are due to the ideas of the electrical inspectors. While the inspectors are somewhat more uniform in their requirements, we have run into several cases where inspectors working for the Underwriters' Laboratories have refused to approve switches which are approved by the Underwriters' Laboratories for the services on which they were placed and although the switches bore the Underwriters' label. Another inspector refuses to permit the use of a solid neutral even though it is approved by the code.

It is not to be expected, of course, that industrial engineers can agree on a certain general type of safety switch for all purposes, but it does appear that a great deal of work will have to be done toward the adoption of some general type of service switch that will meet the approval of those in charge of meter installations

of large utilities and that will also meet the approval of the various inspectors who have jurisdiction over this kind of work.

Because of these conditions this company manufactures ten different kinds of two-pole, 30-amp., 125-volt service switches, whereas if the authorities would agree on the one best type and then all localities would agree to permit the use of that type it would only be necessary for us to manufacture the one type. This would save us a great deal of money, and as this saving would be passed along, it would eventually reach the consumer and would be of benefit to every one who has anything to do with the industry.

Increases Cost

And so it is in many other lines where inspection requirements differ. If one type could be made that would be acceptable to all states and municipalities, manufacturers could put that number into quantity production and turn them out at a low price. As things stand, however, the volume is cut up into five, ten or twenty styles, all duplicating except in some superficial detail, and the overhead cost goes up both for the maker and the distributor.

In Massachusetts the Boston jobber must carry in stock a type of switch which is required in Boston. He must also carry in stock another switch which is almost the same but does not meet the Boston requirements, although it is commonly used in other localities surrounding Boston. He must, in addition, carry in stock a cheap inclosed switch to meet the requirements in localities where inclosed switches are specified with no particular type mentioned. Then he must have the old cheap switch to meet the demand in the localities where even inclosed switches have not as yet been required. It is not hard to see how this affects the Boston jobber.

Here is a matter of fundamental importance. The purpose of all these inspectors and all this legislation is to make the use of electric service safe, and the electrical manufacturer and jobber is ready to co-operate in every way But when a safer way is found, by the very nature of the thing, it must be as safe in Oregon as in Pennsylvania. Therefore the industry should be permitted to make the safe switch without burdening its cost with a whole assortment of excess varieties. And the jobber should be permitted to stock and sell that switch without investing money and filling shelves with duplicating styles that slow down his turnover and increase the cost of distribution.

It is time that our associations, representing all branches of the industry—for all are concerned and should be interested—take up the task of reconciling these inspection inconsistencies. It will be a work of education, but the need is so urgent and the purpose so obvious and commendable that it should be possible to make rapid progress.

Business Conditions

A Survey of Important Developments in the Electrical Market Including Data on Production, the Sales Outlook, Credits, Exports, the Metals and Other Conditions Affecting Cost, Supply and Demand

Conduit Boxes Are Plentiful

Notwithstanding the uneven stocks of rigid conduit reported from many sections, the supply of conduit boxes appears to be comfortably meeting current demands, and the recent price advance in pipe and other steel products has not at this writing been applied to this line of supplies. The increasing use of metallic conduit, both rigid and flexible, tends to develop a wider market for boxes; but so far it has been no very difficult matter to maintain adequate stocks in most quarters, though there is no ground for becoming careless in ordering when inventories shrink materially. There is nothing of a spectacular character about today's box demand as reported to this journal Monday. Contractor-dealers are the principal buyers, and jobbers are worrying over other topics than this.

Instrument Demand Improving

Demand for electrical instruments is improving, according to several manufacturers in the field. A slight betterment in the automotive industry is reported, the orders from the farm-lighting plant makers are steady, the central stations are buying in fair amounts, and inquiries from boiler plants are growing. Stocks of general lines are normal, and makers state that special orders are being made up in satisfactory time. No trouble in deliveries of materials is reported. The present volume of business is expected to continue at a normal rate and, according to the leading manufacturers, can do nothing but improve when the heavier buying starts in the late summer or early fall months. Manufacturers are particularly optimistic over this year's business in view of the heavy construction programs and general business conditions.

Chicago Collections Better

Some indications that collections among Chicago electrical jobbers are improving may be taken from their reports that a greater number of customers are taking advantage of cash discount terms. The volume of purchasers benefiting by cash payments within ten days is constantly growing. On an average the regular collections are running around forty-five to fifty days, which is much better than last year's.

Commenting on this situation, J. P. Wilson, credit manager Central Electric Company, declared that for the last three months of 1922 his collections had been the best of the entire year. The only item necessitating careful scrutiny as to credit rating, he maintained, was the radio business, which was not allowed to run over thirty days. Other jobbers report that the year ironed out many of the credit difficulties, so that conditions in the Middle West were much better than in 1921.

Expect Firm Prices for Farm-Lighting Sets

Improved agricultural conditions throughout the country are expected to bring about a better market for farm-lighting plants during the summer months. Several large companies are planning extensive sales campaigns to educate the farmer in the money-saving features of the lighting sets in order to make 1923 a record selling year. It is also planned by companies to send many more demonstration sets mounted on light automobile trucks to the rural districts. The outlook in the southern districts is encouraging. Several well-known jobbers state that they are in receipt of many inquiries from farmers as a result of advertising in the newspapers, and that as soon as the roads are in better condition they will be allowed to close quite a few orders. This advertising offers from twelve to twenty installment payments. Manufacturers generally are of the opinion that prices will remain firm during the next three months.

Tape Demand Reflects Steadiness in Wiring Field

A steady demand for tape, following a lull of short duration, appears to have set in. Local stocks have been meeting current requirements readily, but the market continues to be characterized by sharp distinctions in quality and price and accompanying spotty buying from particular localities. There is some discussion in manufacturing circles relative to price levels, some of the

newer comers into this field having quoted on bases which some of the older houses have questioned as insufficient to cover all charges properly belonging to this commodity in its journey from the raw-material stage to the distributor's shelf. Be this as it may, the importance of careful buying of tape for the particular service expected seems to be gradually getting more recognition, and the factor of quality is bound to grow in significance. Black tape is in much greater demand than white, and the striking success of interior-wiring campaigns the country over is sure to help the year's sales record in this line.

Electrical Opportunities in China

American Capital Needed to Aid in the Development of Industry and Transportation

"Despite unfavorable political conditions which show no indication of early improvement, commercially speaking, China is solvent," said Julean Arnold, commercial attaché to the American Legation at Peking, in a recent interview with a representative of the ELECTRICAL WORLD. "Once again, for the twentieth time in the past two decades, China's foreign trade shows an increase over the preceding year. Neither the domestic political condition nor the widespread depression of business in many parts of the world in 1922 breaks the continuity of the gradual upward development in foreign commerce. China's per capita debt is under $3, and the entire debt is no more than the funded debt of New York City. The number of Chinese banks in various trade centers is increasing, and important investments are being made in the country by Belgian, British and French interests.

Mr. Arnold pointed out that American trade with China has now reached about $200,000,000 per year, or a fourfold increase since 1900. The total American resident population is about 12,000. The popularity of central-station service is increasing by leaps and bounds, and in the cities where this service is in use the demand for electric lighting overloads the plants every four or five months. New facilities are constantly required. Outline lighting on the Nanking Road, at Shanghai, compares favorably with any American installation. Extensive additions to the station of the Canton electric lighting plant are now under contract.

The competition of cheap electrical supplies made in Japan and in Germany is a present handicap against American goods. Mr. Arnold commended the policy of the General Electric interests in China in refusing to produce cheap supplies in their China factory to meet the competition. It is believed that the quality of American electrical supplies will ultimately win their wide acceptance in China owing to the high regard the Chinaman has for established trademarks and proved goods.

DELINQUENT ELECTRICAL ACCOUNTS FOR JANUARY

Branch and Month	Number of Delinquent Accounts Reported	Total Amount	Average Amount
Central Division:			
December, 1921	1,157	$124,376.98	$107.49
December, 1922	1,104	126,342.89	125.84
January, 1922	820	93,956.53	118.24
January, 1923	809	88,811.52	109.78
New York:			
December, 1921	434	58,840.00	136.00
December, 1922	485	93,428.00	193.00
January, 1922	325	48,429.00	150.00
January, 1923	392	54,452.00	139.00
Philadelphia:			
December, 1921	186	28,992.97	155.87
December, 1922	183	19,307.58	105.51
January, 1922	216	32,449.17	150.23
January, 1923	212	30,786.13	145.22
New England:			
December, 1921	44	8,484.25	192.82
December, 1922	34	3,809.68	112.05
January, 1922	3	454.48	151.49
January, 1923	66	7,805.66	118.27
Pacific Coast:			
December, 1921	23	2,677.74	107.72
December, 1922	14	2,225.43	158.90
January, 1922	16	2,002.00	125.12
January, 1923	12	1,087.20	90.60

Number of Delinquent Accounts Was Lower in January

Delinquent accounts as reported by the Electrical Credit Association show that the Chicago accounts were lowered by 295 over the year end. The average value of the January, 1923, accounts was $109.78 as against $125.84 for December, 1922. This was also lower than the January, 1922, accounts by eleven, with a lowered value of $8.46.

The New York territory also decreased its accounts during the same period from 485 to 392, with an average valuation of $193 and $139 respectively. In Philadelphia the January, 1923, accounts increased from 183 in December to 212, increasing the average valuation during this period from $105.51 to $145.22. The New England accounts changed from 34 in December to 66 in January, 1923, with an average increase in valuation from $112.05 to $118.27. Conditions on the Pacific Coast have improved, since the average accounts have been lowered during this period from $153.90 to $90.60. The list of delinquent accounts is as shown above.

The Metal Market

Major Non-Ferrous Trade Is Active—Lead Shortage Still Acute—Copper 15¼ Cents

The major non-ferrous metal markets continue to show much activity. Copper is quoted at 15¼ cents; the lead shortage is as acute as it has been for many weeks, while zinc has shown a slight softness in price. The tense European situation abroad has had no perceptible effect on prices of any of these metals, and domestic business is reported highly satisfactory by nearly all metal consumers. Domestic markets have been strong enough to permit them to behave independently of Europe.

NEW YORK METAL MARKET PRICES

	Feb. 6, 1923 Cents per Pound	Feb. 13, 1923 Cents per Pound
Copper		
Electrolytic	15.00–15.12½	15.12½
Lead, Am. S. & R. price	8.00	8.00
Antimony	7.50	7.50
Nickel, ingot	30.00	25.00–30.00
Zinc, spot	7.00	7.05
Tin Straits	39.00	40.00
Aluminum, 98 to 99 per cent.	22.00–23.00	23.00

Copper and Brass Products

Copper, brass and bronze mills quote the following prices on brass and copper products:

Copper wire, 17.25 cents net, mill; brass wire, 19.5 to 21.5 cents; copper sheets, 22.50 cents; copper rods, 21 cents; brass rods, 17.50 to 21.62½ cents; sheet brass, 19.25 to 20.87½ cents.

Porcelain Insulator Market Prospects Are Bright

A survey of the porcelain insulator market shows increasing activity and bright prospects for the coming summer months. A slight spurt in sales to the utilities was noted in the trading of last month, and this continues as strong for the first two weeks in February. Jobbers in the Middle West report that they are well stocked and can make deliveries for almost any amount. In the East stocks are fair but not plentiful. Most of the inquiries in the northern sections are for smaller lots, while the line construction programs in the southern districts demand larger amounts and quicker deliveries. Manufacturers are of the opinion that orders from the central stations and telephone companies all through the United States will soon start in heavier volume, and that sales for the next three months will be somewhat larger than they were for the corresponding period of 1922.

Healthy Demand for Washers and Cleaners

Observation of retail sales indicates that washers and cleaners are rapidly getting into the staple class of electrical merchandise and that seasonal conditions are of decreasing importance in this branch of the trade. A

slight recession in demand followed the holidays, and stocks were gradually replenished during January in many quarters. Deliveries are hampered by railroad congestion, but by and large there are no serious shortages reported in this line at the moment. Competition is extremely acute in both washer and cleaner sales. It is doubtful whether recent price movements upward have cut materially into the demand, because of the widespread convenience of deferred payments in retailing this equipment. New methods of merchandising are proving effective, and the nation-wide tendency to equip the homes of workers within the central-station industry with appliances through commercial policies offering employees advantageous terms is bearing fruit in sales. The problem of domestic labor continues acute, and the outlook is bright for the year's business in these classes of equipment.

The Week in Trade

Prices When Quoted Are Those Reported at the Opening of Business on Monday of This Week for Points West of the Mississippi River and on Tuesday for All Eastern Points

DEMAND for electrical commodities throughout the United States is of a steady nature, stocks generally are reported normal and prices of wire and conduit are increasing. A sudden spurt in sales of materials entering into the repair and extension of central-station lines is noted. Meters are said to be selling in better volume. Motors in the smaller sizes are known to be active, most of these entering into the manufacture of fans. Commercial and residential fixture sales are increasing as a result of intensive campaigns in different parts of the country.

Boston Business is improving and railroad difficulties are the only serious obstacle at present to expansion of trade. Building contracts in New England during January totaled $22,770,000, a gain of 9 per cent over December and 42 per cent over January, 1922. Manufacturing continues active. Retail trade still feels the effects of severe weather. Prices are stiffening in tape and steel products. Stocks are short in rigid conduit, pole-line hardware and some sizes of small motors. Inquiries are very active this week in jobbing circles. Central stations are throwing more vigor into commercial developments and appliance sales are keeping up well. Vacuum tubes are scarce in some sizes and cross-arm purchasers are handicapped by delayed shipment conditions. Wiring contractors are extremely busy on residential work.

New York Business continues at a steady gait, and prospects for the coming spring months are thought to be excellent. Motors are selling actively. Renewed interest is being shown in the fixture market, where firm prices prevail. Meters during the week took on strength. Porcelain, high-tension equipment and wire also picked up considerably during the last few days. Jobbers report business a trifle better than it was the week before. Wiring contractors are busy on residential work.

Baltimore Demand for jobbers' stocks is reported only fair. A slight pick-up in the demand for porcelain, wire and pole-line hardware is noted. Residential and commercial fixtures are selling in better volume, and the prospects for this market during the coming summer and fall months are exceptionally bright. Stocks generally are normal and prices are firm.

Atlanta This section was visited by heavy sleet storms the early part of this week, resulting in heavy damage to telephone and local distribution systems and adversely affecting the high-tension lines of the power companies in Alabama. Service has been resumed, but heavy purchases will be made to replace the damaged lines. The improvement and expansion projects of the larger power companies are beginning to get under way, and this is reflected in the volume of sales. Shipments are lengthening and jobbers report low stocks in certain items. General increases in the price of copper wire and conduit are to be noted. Jobbers report business as satisfactory, and all indications point to this being a record year.

Pittsburgh The spirit of optimism is gradually increasing, although this is offset somewhat by the very low prices that are being quoted at some points. The work that is being given out to the electrical contractors is of a larger size in volume of dollars than for some time past. It is possible that the increase in price of various classes of material may cause a tendency to hold up some of the larger jobs. For instance, a job that was let during the past week showed that the last figures were 13 per cent higher than when figured with the materials at the lowest price. During the week conduit has again shown an increase, and it seems to be just about as scarce as ever.

Cleveland A decided upward trend in electrical business is evident, and it is believed that a comparison of January this year with January of 1922 will show a most gratifying increase. The railroads are introducing new cars almost daily and shipments are much improved. Industrial equipment continues to be in strong demand. Small motors particularly are moving rapidly. Building operations here have absorbed a surprising amount of wire and fixtures, while the appliance dealers have not been idle. Washers and cleaner sales have exceeded the most generous estimate. Radio jobbers and dealers are capitalizing the revival of interest in the programs. Stocks are good. Collections are fair.

Chicago Few changes are noted. Present-day buying is steady, while a few jobbers report a seasonal slackening demand on staple materials. But all dealers are optimistic and feel that the year will bring even more business than 1922. Current demand for washing machines and vacuum cleaners has been fairly steady, the volume being determined by sales campaigns. Neither tape nor outlet boxes have given evidence of increased demand, and stocks are normal. Eastern freight embargoes are seriously worrying pole shippers.

St. Paul-Minneapolis Washers and cleaners are steady all around. Business is picking up a little over the slump that followed the holidays. Dealers are inclined to be conservative in buying, but city retail sales seem to be well up to normal. Agents for various lines report a steady business—not above normal, but better than was expected for this winter. Conduit boxes are active. Wiring is steady in both cities, as it has been all winter. Conduit stocks, particularly the small sizes, are still low.

St. Louis The building permits for the month of January, 1923, amounted to $2,560,326 against $1,119,530 for the same month in 1922, or an increase of approximately 127 per cent. It is interesting to note that while the total has increased there has been a decrease of 19 per cent in the amount of the permits issued for manufacturers and workshops as compared with that of the same month one year ago. The various motor manufacturers all report large sales in almost all lines, the orders being considerably in excess of the present production.

Portland-Seattle Much activity is being shown by inquiries about electrical equipment, particularly from the lumber industry. A greater program of electrical development than has been experienced for many years is either in progress now or will soon be started throughout the Northwest. Manufacturers report a slight reduction in transformer costs. The demand for large sizes is very heavy, and deliveries of them are not promised short of a period of six months.

Demand, Supply and Price Trend of Eighteen Commodities as Sold in Sixteen Cities

Explanation:
Demand: Steady, Slow or Active
Supply: Normal, Low or High
Price Trend: Firm, Decreasing or Increasing

Next Week
Reports will include
Storage Batteries, Instruments and Farm Lighting Plants

	Wire	Armored Cable	Conduit	Transformers	Poles	Pole Line Hardware	Porcelain	High Tension Equipment	Fuses	Meters	Switches	Wiring Devices	Lamps	Commercial Fixtures	Motors	Washers, Cleaners	Conduit Boxes	Tape
Boston																		
Demand	Act.	Act.	Act.	Slow	Slow	Sdy.	Slow	Slow	Sdy.	Sdy.	Act	Act.	Act.	Sdy.	Sdy.	Sdy.	Act.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Low	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Inc.
New York																		
Demand	Act.	Act.	Sdy.	Slow	Slow	Sdy.	Sdy.	Slow	Act.	Sdy.	Sdy.	Sdy.	Act	Sdy.	Sdy.	Act.	Sdy.	Slow
Supply	Nml.	Hi.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Firm	Inc.	Firm	Firm	Firm	Firm	Inc.	Inc	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm
Baltimore																		
Demand	Act.	Slow	Act.	Sdy.	Slow	Slow	Sdy.	Slow	Act.	Slow	Act.	Act.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.
Supply	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Dec.	Firm	Firm	Firm
Atlanta																		
Demand	Act.	Act.	Act.	Sdy.	Act.	Act.	Act.	Slow	Act.	Act.	Act.	Act.	Act.	Act.	Slow	Slow	Act.	Act.
Supply	Low	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm
Pittsburgh																		
Demand	Act.	Sdy.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.
Supply	Low	Nml.	Low	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Cleveland																		
Demand	Act.	Sdy.	Act.	Slow	Slow	Slow	Slow	Slow	Sdy.	Sdy.	Act.	Act.	Act.	Act.	Act.	Act.	Sdy.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Firm	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm.	Firm	Firm	Firm	Firm	Firm	Firm	Firm
Chicago																		
Demand	Act.	Sdy.	Act.	Sdy	Act.	Slow	Slow	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Sdy.	Act.	Sdy.	Sdy.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Inc.	Inc.
St. Paul-Minneapolis																		
Demand	Act.	Slow	Sdy.	Sdy.	Act.	Act.	Act.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Slow	Sdy.	Act.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Firm	Inc.	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm
St. Louis																		
Demand	Sdy.	Sdy.	Act.	Sdy.	Slow	Sdy.	Sdy.	Act.	Sdy.	Slow	Sdy.	Sdy.	Sdy	Act.	Act.	Act.	Slow	Act.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.
Price trend	Inc.	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm
New Orleans																		
Demand	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Slow	Slow	Sdy.	Sdy.	Sdy.	Act.	Act.	Act.	Sdy.	Slow	Sdy.	Slow
Supply	Low	Nml.	Low	Nml.	Low	Low	Nml.	Low	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Inc.	Inc.	Firm	Firm	Firm	Firm	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm
Denver																		
Demand	Act.	Act.	Act.	Slow	Act.	Act.	Act.	Slow	Act.	Slow	Sdy.	Act.	Sdy.	Act.	Slow	Sdy.	Act.	Sdy.
Supply	Nml.	Low	Low	Low	Nml.	Low	Low	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Inc.	Inc.	Firm	Firm	Inc.	Firm	Firm	Inc.	Firm	Firm	Inc.	Firm	Firm	Firm	Inc.	Inc.	Inc.
Salt Lake City																		
Demand	Act.	Sdy.	Act.	Sdy.	Sdy.	Slow	Act.	Sdy.	Slow	Sdy.	Sdy.	Sdy.	Act.	Act.	Slow	Sdy.	Sdy.	Sdy.
Supply	Low	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Hi.	Nml.	Nml.	Nml.	Hi.	Nml.	Nml.	Low	Nml.	Nml.
Price trend	Inc.	Firm	Inc.	Firm	Inc.	Inc.	Inc.	Firm	Firm	Firm	Firm	Inc.	Firm	Inc.	Firm	Inc.	Firm	Firm
Portland-Seattle																		
Demand	Act.	Act.	Act.	Act.	Act.	Act.	Slow	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.
Supply	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.
Price trend	Inc.	Firm	Inc.	Firm	Inc.	Firm	Firm	Firm	Firm	Firm	Firm	Inc	Firm	Firm	Firm	Firm	Firm	Firm
San Francisco																		
Demand	Act.	Sdy.	Act.	Sdy.	Sdy.	Act.	Sdy.	Sdy.	Sdy.	Sdy.	Sdy.	Act.	Act.	Act.	Sdy.	Act.	Act.	Act.
Supply	Hi.	Nml.	Low	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Nml.	Low	Nml.	Nml.	Nml.	Hi.	Nml.	Low
Price trend	Firm	Firm	Firm	Firm	Firm	Firm	Dec.	Firm	Inc.	Firm	Inc.	Inc.	Firm	Dec.	Firm	Firm	Firm	Inc.

The local supply of distribution size transformers is normal. The demand for lead-covered cable, particularly paper-insulated, is active and deliveries cannot be obtained in less than ten months. Conduit stocks are still in a depleted condition, although new shipments are expected daily. Building construction, however, is so active that the demand for conduit continues to keep in advance of incoming stocks. A drop is reported in porcelain knobs and tubes. Prices on conduit are reported to be 5 to 10 per cent higher.

San Francisco Constructive efforts are being made by electrical manufacturers and jobbers to ascertain the best type of motor, cord, lighting or wiring for each particular industry. Very satisfactory are the Department of Agriculture reports of California's 1922 crop total, which constituted a record tonnage. Growers received $183,000,000 for field crops, $194,000,000 for fruit and $19,000,000 for vegetables and cantaloupes. Moreover, 1922, with nearly 15,500,000 cases, set a new record for fruit packing. These totals explain why prosperous retail conditions prevail throughout the state.

Denver Improved status of basic commodities is reflected in increasing electric equipment orders and in improvements and extensions to central-station service to accommodate new business. Inquiries and purchases from railroads and industrial plants are likewise increasing daily. Local jobbers' and manufacturers' stocks are meeting normal requirements, but slow deliveries rather than increases in prices are preventing completion of stocks for business anticipated in early spring.

Salt Lake City This week is "Intermountain Products Week," and a big drive to stimulate interest in home products is now in progress. Every department of manufacture is represented in the campaign, and by lecture display and demonstration the economic doctrine is being proclaimed that local products should have preference over their competitors, provided they offer equal value.

Activities of the Trade

Devoted to News of the
Manufacturer, Jobber, Agent, Contractor and Dealer, Including Important Orders and Contracts for Apparatus and Equipment

Milwaukee's Fixture Industry Seen by Foreign Delegates

The manufacturing, jobbing, wholesaling and retailing of electrical fixtures in Milwaukee is being studied by a delegation of lighting experts from London, Paris, Shanghai and Tokio who are making tours of inspection in the leading electrical centers of the country. Included among the many electrical manufacturing concerns in Milwaukee to be visited by the delegates is the Julius Andrae & Sons Company.

Radio Corporation Patent Suit

Judge Augustus N. Hand, in the United States District Court for the Southern District of New York, has handed down decisions in three patent suits brought by the Radio Corporation for infringement of the De Forest audion patents by the manufacture and sale of vacuum tubes for radio purposes. In all three cases Judge Hand granted preliminary injunctions asked for. The first of these suits was that of the Radio Corporation of America against La France Import & Sales Company, Inc., and others manufacturing and selling a vacuum tube known as the "La France" detector and amplifier. The second suit was against Harry Rosenthal and others who are manufacturing and selling a vacuum tube detector and amplifier known as the "Perfection" tube. The third suit was against the Radio Guild, Inc.

Atlanta Sales District of Westinghouse Lamp Meets

The annual meeting of the Atlanta sales district of the Westinghouse Lamp Company was held in Atlanta on Feb. 1 to 3, inclusive. This district embraces the Southeastern States, and a representative attendance of executives and salesmen was reported. The meeting was featured by discussions on sales promotions through merchandising and advertising mediums and the discussions of technical problems by the company's illuminating and commercial engineers.

Mercury Company Increases Capacity to 7,200 Trailers

By the addition of a new one-story building, 100 ft. x 60 ft., the Mercury Manufacturing Company, Chicago, will be able to turn out 7,200 electric trailers per year, according to officials of that company. This additional space was used to simplify and unify production which has resulted by the addition of only a few more men.

Total sales for the year, according to a statement made by J. R. Beansley, general manager, ran about twice that of 1921. With large industries recognizing the problem of internal transportation as one of paramount importance, Mr. Beansley expects business for the coming year will increase steadily.

G. E. Wins Preliminary Injunction in Incandescent Lamp Suit

The General Electric Company has been granted a preliminary injunction against P. R. Mallory & Company, Portchester, N. Y., manufacturers of tungsten wire, and the Save Electric Corporation, Brooklyn, manufacturer of incandescent lamps. These injunctions are based upon the General Electric Company's broad tungsten-lamp patent of Just & Hanaman and upon the Langmuir gas-filled lamp patent. Both of these patents have been sustained by the Circuit Court of Appeals in previous litigations. The effect of these injunctions will be to prevent defendants from continuing the manufacture and sale of their products, pending the final outcome of the litigation.

Apex of Denver to Double Force in House-to-House Campaign

The Apex Distributing Company of Denver, which since its organization a year ago has maintained headquarters in a downtown office building, has leased half of the ground floor of the new Wilda Building, at 1437 Welton Street in that city. Plans have been completed for doubling the sales force with the intention of starting a house-to-house campaign covering every corner of the city.

Wagner Electric January Sales Showed Large Increase

January sales of the Wagner Electric Corporation are reported by the company as 90 per cent greater than those of January, 1922, and the December sales were 60 per cent in excess of those of December of the previous year. Among the important contracts recently secured by the company are the complete electrical equipment of the Missouri Portland Cement Company for its local plant improvements, the complete motor installations of the new power plant of the Union Electric Light & Power Company at Cahokia, Ill., and the motors to be used in the electrification of the local plants of the N. K. Fairbanks Company, the Benjamin Moore Paint Company and the Alton Brick Company.

Westinghouse Receives $500,000 Railroad Order

Because of a large increase in traffic, the Long Island Railroad, which handles probably the heaviest suburban traffic in the world, has just purchased from the Westinghouse Electric & Manufacturing Company forty motor-car equipments, twenty trail-car equipments and four baggage-mail-car equipments. The baggage cars will be equipped with Westinghouse type 308 D-7 field control motors and Westinghouse electropneumatic control. In order to take care of the increase in power demand when this new equipment is put into service, it has been necessary to increase the substation capacity of the railroad, and an order has been placed, also with the Westinghouse company, for one 4,000-kw. and one 3,000-kw., six-phase, 25-cycle, 650-volt converter with the necessary transformers. The entire order amounts to over half a million dollars.

Allis-Chalmers Net Profits in 1922 Were $2,208,549

The Allis-Chalmers Manufacturing Company, Milwaukee, Wis., manufacturer of electrical machinery, in an earnings statement for the fourth quarter of 1922, shows a net profit of $479,985.70. Sales billed amounted to $5,863,654.23. Detailed figures for the last three months of the year follow:

	Sales Billed	Net Profit
October	$1,858,424.23	$160,309.42
November	1,823,878.58	162,389.24
December	2,181,351.42	157,287.04
	$5,863,654.23	$479,985.70

In closing for the year 1922 there has been transferred to earnings an amount of $524,619.13, representing balance of reserves set aside in prior periods on certain contract guarantees which have since expired. These reserves are therefore now definite earnings, as is likewise $175,000 received in part settlement of a foreign contract.

The billing and net profit for the four quarters of 1922 follow:

	Sales Billed	Net Profit
First quarter	$4,671,602.78	$278,733.30
Second quarter	4,778,863.42	299,796.04
Third quarter	5,479,925.26	450,415.00
Fourth quarter	5,863,654.23	479,985.70
Add for reserves transferred to earnings as explained above		699,619.13
	$20,794,045.69	$2,208,549.17

Reorganize Washing Machine Firm

Announcement is made that the Holland Manufacturing Company, Holland, Mich., manufacturer of electric washing machines and ironers, has been reorganized and now is known as the Holland Maid Company. The latter company has bought the land, buildings, machinery, stock and patents of the former concern, and is capitalized at $400,000.

Foreign Trade Notes

PROPOSED RAILWAY ELECTRIFICATION IN BRAZIL.—In a message from the President of the State of São Paulo to the Congress of that state, according to *Commerce Reports*, credit to the amount of 1,297,418 milreis has been asked for the purpose of electrifying the Campos do Jordão Railway in Brazil. The railroad is a branch line, 50 miles long, extending north from Pindamonhandaba on the Central Brazil Railway. Energy to operate the road can be supplied by the São Paulo and the Rio de Janeiro electric companies. The system to be adopted will be either single-phase, 10,000 volts to 15,000 volts, or direct current at 1,200 volts to 3,000 volts.

EXTENSIONS TO THE ELECTRIC SYSTEM IN ROME, ITALY.—An appropriation of 20,569,100 lire was authorized by the Communal Council of Rome last June, according to *Commerce Reports*, for the purpose of extending the plants and system for generating and distributing electricity for the municipality of Rome. The work includes increasing the capacity of the flume at the central station of Castelmadama from a flow of 20 cu.m. to 25 cu.m. and the installation of turbo-generators at a cost of 2,500,000 lire; the erection of a 60,000-volt transmission line from Terni to Rome and a transformer station to carry the current received from the Visso station of the Alto Nera Company or from the commune's own generating station now under construction on the Nera, to cost about 12,700,000 lire; the installation of a new generator, boilers and auxiliary equipment in the central station at Montemartini, to cost 5,800,000 lire, and extension of distribution lines to furnish service to new consumers and to furnish more public lighting, at a cost of 1,500,000 lire.

Foreign Trade Opportunities

Following are listed opportunities to enter foreign markets. Where the item is numbered further information can be obtained from the Bureau of Foreign and Domestic Commerce, Washington, by mentioning the number.

Purchase is desired in Mexico (No. 5,349) for self-contained gasoline motor-operated electric plant for ranch house, to supply current for lamps and refrigerator, including gasoline engine, refrigerator and accessories.

Purchase and agency is desired in the Netherlands (No. 5,356) for high-grade electrical household appliances, especially washing machines, cookstoves, flatirons, teakettles, fans and refrigerators.

An agency is desired in South Africa (No. 5,358) for radio apparatus.

Purchase and agency is desired in Poland (No. 5,362) for wire for winding dynamos and apparatus for measuring electric current.

Purchase and agency is desired in Scotland (No. 5,363) for electric lamps for home and for motor cars, electric air pumps for automobiles, electric plants for home use, and wireless apparatus.

Purchase is desired in Mexico (No. 5,382) for one oil-engine generator set, 10 kw. to 12 kw., to operate on fuel oil.

An agency is desired in Norway (No. 5,402) for electrolytic copper of the usual size.

New Apparatus and Publications

UNDERFEED STOKER.—The Sanford Riley Stoker Company, Worcester, Mass., has issued publication No. 61, describing the Jones "A-C" automatic underfeed cleaning stoker.

ELECTRIC REFRIGERATING MACHINE.—The Koldak Company, Springfield, Mass., is distributing a booklet in which it describes the new "Koldak" household electric refrigerating machine. This machine can be applied to any existing ice box.

ELECTRIC IRONER.—An electric ironer, "Du-All," has been put on the market by the Horton Manufacturing Company, Fort Wayne, Ind.

AUTOMATIC MIXER.—An improved-style mixer with the motor placed in the base has been developed by the Arnold Electric Company, Racine, Wis.

VACUUM SWEEPER.—An electric vacuum sweeper has recently been placed on the market by the Hamilton Beach Manufacturing Company, Inc., Racine, Wis.

ELECTRIC CLOTHES WASHER.—A vacuum-cup-type electric clothes washer has been developed by the Horton Manufacturing Company, Fort Wayne, Ind.

ELECTRIC DISHWASHER.—The Family Dishwasher Company, Black Earth, Wis., has placed on the market an electric dishwasher.

PUMPING COMPRESSOR.—A direct pumping compressor designed especially for gasoline filling stations has been placed on the market by the Kellogg Manufacturing Company, Rochester, N. Y.

BUFFING AND POLISHING MACHINE.—A direct-driven buffing machine equipped with roller bearings has been developed by the Cleveland Armature Works, Inc., 4,732 St. Clair Avenue, Cleveland.

SMALL TURBINE-GENERATOR SET.—The Moon Manufacturing Company, 108 North Jefferson Street, Chicago, has placed on the market a small turbine-generator set of 1½ kw. capacity.

ELECTRIC HEATER AND COOKER.—The Rogers Electric Laboratories Company, 2,015 East Sixty-fifth Street, Cleveland, has placed on the market an electric heater and cooker.

GENERATOR SET.—The Climax Engineering Company, Clinton, Iowa, has brought out a generator set consisting of a continuous-current generator directly connected to a four-cylinder gas engine, which is manufactured in sizes ranging from 15 kw. to 50 kw.

BATTERY CONTAINER.—A one-piece battery container made of an impregnated fiber composition has been placed on the market by the Ahlbell Battery Container Corporation, Waukegan, Ill.

BURGLAR-ALARM SYSTEM.—An improved burglar-alarm system has been developed by the Metropolitan Electric Protective Company, 233 Seventh Avenue, New York City.

AUTOMATIC TIME SWITCH.—An automatic time switch with an eight-day movement, designed particularly for furnishing artificial daylight in henhouses, has been developed by the A-A Manufacturing Company, 128 East Twenty-third Street, New York City.

ELECTRIC LAMPS.—The Localized Lighting Corporation of Ameleco, 540 West Fifty-eighth Street, New York City, has developed a typewriter lamp which can be attached to the back of the typewriter frame and which closes with the desk. The company has also brought out a lamp, "Han-D-Lite," which can be attached to the bed, chair or other places for concentrating the light directly on any special object.

DISHWASHER.—An electric dishwasher for the drainboard of the kitchen sink has been developed by the Milwaukee Dishwasher Company, Inc., Milwaukee.

COUNTERFEIT DETECTOR.—The Teller Manufacturing Company, 149 Broadway, New York City, has placed on the market a new electrical device, "The Teller," for the detection of counterfeit money and altered paper.

New Incorporations

THE DORSET (VT.) ELECTRIC LIGHT COMPANY has been incorporated with a capital stock of $10,000 by Edwin Lefebvre, Ernest West, William M. Batchelder and H. N. Williams, all of Dorset.

THE CYR ELECTRIC COMPANY, Van Buren, Me., has been incorporated with a capital stock of $10,000 to generate and distribute electricity in Cyr and Hammond plantations. The officers are: Elzear Papointe, president; Napoleon Papierre, treasurer, and O'Neil Lapierre, clerk.

THE ELEZABETHTOWN (ILL.) POWER & LIGHT COMPANY has been incorporated with a capital stock of $20,000 by George W. Ledbetter, Elisha L. Robinson, Earl T. Galloway and Earl C. Gaines, Jr.

THE PEOPLE'S ELECTRIC SERVICE COMPANY, Elkader, Iowa, has been incorporated with a capital stock of $750,000 to take over the property of the Turkey River Power Company. The officers are: F. H. Schmidt, president; William Allyn, vice-president; William C. Reimer, secretary and treasurer, and E. S. Gage, manager.

Construction News

Projects, Plans, Bids and Contracts, Contemplated or Under Way

New England States

PORTLAND, ME.—Electric traveling cranes and other electric equipment will be installed at the proposed new freight terminal of the Portland Terminal Company, to cost about $1,500,000.

CLAREMONT, N. H.—At the March town meeting the proposal to install a new lighting system in the business district will be submitted to the voters. The cost is estimated at about $25,000.

BELLOWS FALLS, VT.—The installation of an ornamental lighting system in the business district, to cost about $10,000, has been authorized.

SPRINGFIELD, MASS.—Electric power equipment will be installed at the plant of the Eastern States Refrigerating Company, Bridge Street, in connection with additions and improvements, to cost about $200,000.

PITTSFIELD, MASS.—The Pittsfield Electric Company has secured permission to issue $125,000 in capital stock, the proceeds to be used for extensions and improvements.

HARTFORD, CONN.—The Standard Mattress Company, 71 North Street, plans to erect an addition to its power house.

Middle Atlantic States

ROCHESTER, N. Y.—The Rochester Gas & Electric Corporation has petitioned the Public Service Commission for approval of franchises issued by the towns of Victor, Mendon, Henrietta and Bloomfield and the villages of Holcombe and East Bloomfield granting the company permission to extend its electric lines to furnish electricity in those places. If the petitions are granted, the company plans to erect 12 miles of line in Henrietta and 8 miles in Holcombe and East Bloomfield. Contracts have already been drawn up for street-lighting systems in both towns.

SYRACUSE, N. Y.—Work will begin as soon as the weather permits on the construction of a new power house for the Crouse-Irving Hospital, to cost about $40,000. Dr. W. L. Wallace is the head of the institution.

BERKELEY HEIGHTS, N. J.—Electric power equipment will be installed at the local cold-storage insulation manufacturing plant of the J. H. Stone Corporation, in connection with rebuilding the portion recently destroyed by fire. The loss is estimated at $150,000.

ROOSEVELT, N. J.—Electric power equipment will be installed at the local plant of the Armour Fertilizer Works, 209 West Jackson Boulevard, Chicago, in connection with rebuilding of the portion recently destroyed by fire with loss estimated at $75,000.

BERNVILLE, PA.—The property of the Bernville Electric Light, Heat & Power Company has been purchased by Shower Brothers. The new owners, it is understood, will make extensive improvements to the system.

HOLTWOOD, PA.—Investigations, it is reported, are being made by the Pennsylvania Water & Power Company in connection with the construction of two additional hydro-electric generating units. The cost is estimated at $750,000.

INDIANA, PA.—E. G. House, operating the coal properties of the Manufacturers' Coal Company, Yellow Creek section, is planning to install electric power and mechanical equipment.

KEPLERS, PA.—The Binney & Smith Company, 41 East Forty-second Street, New York, is taking bids for the installation of a power house at its local plant. Lockwood, Greene & Company, 101 Park Avenue, New York, are engineers.

NANTICOKE, PA.—The Susquehanna Collieries Company, Commercial Trust Building, Philadelphia, will install electric power equipment in connection with the rebuilding of its local coal breaker, recently destroyed by fire, causing a loss of about $750,000.

FAYETTEVILLE, PA. — The plant of the Fayetteville Electric Light & Power Company has been purchased by the Potomac Public Service Company, Hagerstown, Md. The new owner will take possession June 1.

PITTSBURGH, PA. — The Duquesne Light Company has secured permission to acquire the following companies: Avalo Light, Ben Avon Light, Robinson Township Light, Neville Township Light, Emsworth Township Light, Stowe Township Light, Bellevue Light, Kennedy Township Light, Kilbuck Township Light, Haysville Light, Glenfield Light and Coraopolis Light companies. Extensions and improvements will be made to the systems.

PHILADELPHIA, PA.—Bids will be received by the United States Engineer Office, 815 Witherspoon Building, until Feb. 23 for one Diesel engine, with accessories and spare parts.

PHILADELPHIA, PA.—The Philadelphia Suburban Gas & Electric Company, West Washington Square, has issued $650,000 in bonds, part of the proceeds to be used for extensions in the Cromby electric plant, to increase the capacity from 10,000 kw. to 20,000 kw.

ANNAPOLIS, MD.—The Annapolis Public Utilities Company has been granted permission to change its name to the Severn Light & Power Company and extend its plants and system. Bonds for $700,000 will be issued, part of the proceeds to be used for the acquisition of plants at Laurel and Bowie and for additions and improvements to same.

BALTIMORE, MD. — The Baltimore & Ohio Railroad Company will install electric power equipment at its proposed grain elevator in the Locust Point section, to cost $4,000,000.

CUMBERLAND, MD. — The American Water Works & Electric Company has secured permission to acquire the Cumberland Edison Power Company. Extensions will be made to the plant and system.

ELKTON, MD.—The Susquehanna Power Company is preparing plans for the construction of a hydro-electric power plant at Conowingo, on the Susquehanna River, to cost about $600,000.

HAGERSTOWN, MD.—The Pennsylvania Railroad Company will electrify its local engine terminals.

BECKLEY, W. VA.—The installation of an ornamental lighting system on Main Street is under consideration. W. L. Foster is manager of the Beckley Electric Light & Power Company.

HUNTINGTON, W. VA.—The Mountain State Coal & Gas Syndicate, recently formed with a capital of $2,000,000, will install electric power and mechanical equipment at its local properties. Thomas W. Jones, Middleport, Ohio, is president.

RAINELLE, W. VA.—The East Rainelle Light & Power Company will build a transmission line from Rainelle to East Rainelle, to cost about $15,000.

FREDERICKSBURG, VA.—The Spottsylvania Power Company is planning to construct an auxiliary generating plant with initial capacity of 1,000 hp., using Diesel engines.

NORFOLK, VA.—Plans are being considered for replacing the present arch lamps on Granby, Main and Church Streets with pedestal lamps.

WASHINGTON, D. C.—Bids will be received by the Bureau of Supplies and Accounts, Navy Department, until Feb. 27 for 4,200 ft. electric wire for the Mare Island Navy Yard (Schedule 465); for 1,000 ft. single conductor lighting and power wire for the Philadelphia Navy Yard (Schedule 487); also until Feb. 20 for 1,600 ft. of rubber-covered cable for the Hampton Roads Navy Yard (Schedule 482).

North Central States

BAD AXE, MICH. — The Great Lakes Power Company plans to erect a transmission system to cover 175 miles, to cost about $500,000. Power will be furnished by the Marysville plant of the Detroit Edison Company.

BYRON CENTER, MICH.—The Wyoming Light & Power Company contemplates extending its service to Byron Center during 1923, provided that a right-of-way for a transmission line can be obtained between Byron Center and Wyoming Park.

ISHPEMING, MICH.—The Michigan Gas & Electric Company it is reported, will soon ask for bids for equipment for its proposed hydro-electric plant to be erected on the St. Joe River, near Mottville, to cost about $400,000. Holland, Ackerman & Holland, 52 West Jackson Boulevard, Chicago, are engineers.

AKRON, OHIO. — The Northern Ohio Traction & Light Company is planning to erect two new substations, one at Akron and the other in Ravenna.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, until March 2 for substation switching equipment.

CLEVELAND, OHIO.—Bids will be received at the office of the commissioner of purchases and supplies, City Hall, Cleveland, until Feb. 23 for one steam-jet ash conveyor and one 40-ton ash storage tank at the City Hospital.

CHICAGO, ILL.—The South Side Laundry Company, 2820 South Wabash Avenue, will build a power plant at its works, to cost $75,000. Ronnenberg, Pierce & Hauber, 10 South La Salle Street, are architects.

FORRESTON, ILL.—The Illinois Central Railroad Company, 135 East Eleventh Place, Chicago, has completed plans for the construction of a local power plant, to cost about $80,000.

OTTAWA, ILL. — The National Plate Glass Company, General Motors Building, Detroit, will build a power house in connection with proposed extension to its local plant, known as the Federal Plate Glass Company, to cost about $5,000,000.

PEORIA, ILL. — The Central Illinois Light Company is preparing plans for an electric power plant, to cost about $2,000,000.

GREEN BAY, WIS. — The Wisconsin Public Service Corporation, which is building an 8,000-hp. hydro-electric plant at High Falls, near Pound, it is stated, will begin work about April 1 on a hydro-electric development of the same capacity at Cauldron Falls, 10 miles north of the High Falls plant.

LA CROSSE, WIS.—Plans are being prepared by O. A. Merman, architect, Linker Building, for a power house, to cost about $125,000, and also for a nurses' home for the Lutheran Hospital.

LA POINTE, WIS. — Steps have been taken to organize a company, to be capitalized at $10,000, for the purpose of furnishing electricity for lamps and motors in La Pointe and nearby places. One of the first extensions contemplated is to supply electric service to Madelaine Island. Electricity will be purchased from a power plant for which plans are under way.

LUCK, WIS.—The Railroad Commission has granted the Luck Light & Power Company permission to issue $15,000 in capital stock, the proceeds to be used to purchase the local electric plant and system, owned by Anton K. Pederson, and for extensions to same.

MILWAUKEE, WIS. — The Pittsburgh Plate Glass Company has engaged Cahill & Douglas, consulting engineers, 217 West Water Street, Milwaukee, to prepare plans for a steam-driven electric generating plant, to cost about $135,000, for the Patton-Pitcairn division of the company. The equipment will include generators, engines, boilers, automatic stokers, fuel and ash-handling equipment, etc.

OCONTO, WIS.—The Northeastern Power Company, recently organized, has applied to the Railroad Commission for permission to issue $120,000 in capital stock for the purpose of acquiring the properties of the Oconto Service Company and the Peshtigo (Wis.) Electric Company.

OWEN, WIS.—Bids will be received by C. L. Johnson, village clerk, until Feb. 21 for an ornamental street-lighting system, to include 30 lamps, in connection with street paving. The Universal Engineering Company, Eau Claire, is engineer.

SUPERIOR, WIS.—At an election to be held April 3 the proposal to purchase the electric plant of the Superior Water, Light & Power Company, to be owned and operated by the municipality, will be submitted to the voters.

VIRGINIA, MINN. — The Water and Light Commission has applied to the Council for authority to issue certificates of indebtedness to the amount of $125,000 for the purpose of installing additional boilers in the water and light plant.

HIBBING, MINN.—The Oliver Iron Mining Company, Duluth, will install electric power equipment in connection with its proposed local screening and crushing plant, to cost about $600,000.

DES MOINES, IOWA.—A two-story heating plant, power house and laundry, to cost about $100,000, will be erected at the Methodist Hospital this year.

LE MARS, IOWA.—The Board of County Supervisors has granted the Iowa Light, Heat & Power Company permission to erect a transmission line from the town of Le Mars to Merrill.

SIOUX CITY, IOWA.—Tentative plans are under consideration by the Sioux City Gas & Electric Company for the construction of a new power plant, to cost between $2,000,000 and $2,500,000.

HOLDEN, MO. — Electrically operated pumping machinery will be installed in connection with improvements to the municipal waterworks system, to cost about $80,000. The Benham Engineering Company, Gumbel Building, Kansas City, Mo., is engineer.

POPLAR BLUFF, MO.—Electric power equipment will be installed in the proposed new ice-manufacturing plant, to have a capacity of 100 tons daily. F. A. Bacon is president.

SHERIDAN, MO.—The Maryville (Mo.) Electric Light & Power Company is planning to extend its transmission line from Parnell to Sheridan to furnish electrical service here.

BEATRICE, NEB.—The Black Brothers Company will build a hydro-electric power plant in the Blue Springs section for flour-mill and other industrial service, to cost $100,000.

PLATTSMOUTH, NEB. — Bids will be received by A. H. Duxbury, city clerk, for installation of an ornamental street-lighting system, to include seventy-one electroliers. Bruce & Grupe, Finance Building, Omaha, are engineers.

DIGHTON, KAN.—The City Council is considering the question of erecting a transmission line to connect with the municipal electric plant at Scott City to secure electricity to operate the local system.

PARSONS, KAN.—The Kansas Gas & Electric Company, Wichita, has started work on the erection of a power plant on the Neosho River, 10 miles from Parsons.

Southern States

AHOSKIE, N. C.—The Town Council has contracted with a number of towns to supply electricity from the municipal electric light plant. The towns that are to secure the service will erect the transmission lines to the local plant.

MOUNT AIRY, N. C.—The North Carolina Granite Company is making inquiries for an engine-generator set of about 100 kw. capacity.

WADESBORO, N. C.—Plans for the new textile mill to be erected by L. D. Robinson, at a cost of $400,000, provide for a power plant.

BELTON, S. C.—The installation of an ornamental lighting system is under consideration.

GREER, S. C.—Plans are under way for extensions in the municipal electric plant to cost $10,000.

ATLANTA, GA.—The Southern Bell Telephone Company plans extensive improvements to its local system during 1923, to cost about $1,277,000, the larger portion of which will be used for laying underground and aërial cables to care for several thousand new applications for service.

DAVISBORO, GA.—The W. G. Warthen Produce Company will install a power house in connection with proposed plant extensions.

MILLTOWN, GA.—Steps have been taken to organize a company, to be known as the Lanier County Power Company. The company will be capitalized at $300,000 and proposes to build a power plant at the foot of Lake Irma in Milltown. The cost is estimated at about $200,000. F. E. Hatch is interested in the company.

MIAMI, FLA. — The installation of an ornamental lighting system on Southeast Second Street and Southeast Second Avenue is under consideration.

JACKSONVILLE, FLA.—The City Council has passed an ordinance for extensions to the municipal electric plant, to cost $850,000. The ordinance provides for an expenditure of $250,000 in 1924, 1925 and 1926. Bids, it is understood, will soon be asked for. At present funds to the amount of $100,000 are available for the work.

CHATTANOOGA, TENN. — The Dixie Portland Cement Company will install electric power equipment at its plant in connection with additions to cost about $200,000.

JONESBORO, TENN.—Repairs will be made to the local susbtation of the Tennessee Eastern Electric Company recently damaged by fire. The loss is estimated at about $25,000.

NASHVILLE, TENN.—Bids will be received at the United States Engineer's office, Nashville, Tenn., until March 6 for one electric towboat.

ALICEVILLE, ALA.—The Pickens County Light & Power Company, recently organized, plans to install a power plant and system for local commercial service. J. V. Park is president.

EAST BIRMINGHAM, ALA.—The George C. Brown Company, Huntsville, Ala., plans to install a power house at its proposed local veneer plant, to cost about $100,000.

GLENDALE, ALA. — J. J. Harrison & Company, Florala, Ala., plan to install a street-lighting system in connection with the development of a 600-acre tract of land.

MONROEVILLE, ALA.—Extensions will be made in the municipal electric power plant, including the installation of new equipment.

GULFPORT, MISS.—The installation of an ornamental lighting system, covering twelve blocks, is under consideration by the city commissioner.

GULFPORT, MISS.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Feb. 26 for the installation of electric lighting systems for each building; power and telephone conduits; outside electric distributing systems, including transformers, panelboards, fixtures, conduits, fiber conduits and wiring, at the United States Veterans' Hospital, Gulfport. (Specification No. 4,774, part IV.)

OKMULGEE, OKLA.—Electrically operated pumping machinery will be installed in connection with extensions and improvements to the municipal waterworks system, to cost about $150,000. T. J. Embree, Okmulgee, is engineer.

PONCA CITY, OKLA. — The Marland Refining Company will install electric power equipment at its local oil refinery in connection with proposed extensions.

TONKAWA, OKLA. — The Comar Oil Company will install electric power equipment at its proposed local refining plant, to cost about $150,000.

PORT ARTHUR, TEX.—A power house will be erected by the Atlantic Refining Company, 3144 Passyunk Avenue, Philadelphia, in connection with its proposed new oil refining plant, to cost about $500,000.

SAN ANTONIO, TEX.—C. H. Alexander, 612 Houston Building, and associates plan to install a hydro-electric power plant. Inquiries are being made for waterwheels, generators, etc.

TAYLOR, TEX.—Plans are being prepared for the installation of an ornamental lighting system in the business section.

TEXAS CITY, TEX.—The Texas Refining Company, recently organized, will install a power house in connection with its proposed local refinery, to cost about $1,500,000. Alexander Smith, of Peabody, Houghteling & Company, 366 Madison Avenue, New York, bankers, is president.

SNYDER, TEX. — The Snyder Utilities Company contemplates additions and improvements to its power plant and system, to cost about $50,000.

Pacific and Mountain States

BATTLEGROUND, WASH.—The Clarke County Light & Power Company plans to install a power plant and system for local commercial service.

HOQUIAM, WASH.—The Grindle Canning Company contemplates the installation of a one-story power house at its plant.

SPOKANE, WASH. — The Washington Water Power Company is planning extensions to its hydro-electric plant at Long Lake to increase the output by 22,500 kw., at a cost of about $250,000.

WALTERVILLE, ORE.—Extensions and improvements to the municipal electric light plant are under consideration by the Water Board. Cary A. McClair is manager.

IGO, CAL. — The California Bimetallic Company, operating local silver mines, will build a transmission line for electric service at its plant, to cost about $30,000.

OAKLAND, CAL.—The Neilson Packing Company will install electric power equipment at its proposed fruit-packing and refrigerating plant on Ninety-ninth Avenue, to cost about $300,000.

SANTA BARBARA, CAL.—The Southern California Edison Company will build a steel-tower transmission line in the Montecito section, 22 miles, to cost $200,000. Improvements will be made in the distributing system at Hanford, to cost $60,000.

SUSANVILLE, CAL.—The construction of an electrically operated railroad, 15 miles long, in the Eagle Lake section, for the purpose of hauling logs to sawmill, is under consideration by the Fruit Growers' Supply Company, First National Bank Building, San Francisco. Electricity to operate the proposed railway would be obtained from the local plant of the Lassen Electric Company.

ADAIR, IDAHO. — Extensions will be made to the power plant of the Montana-Idaho Power Company, to cost about $20,000. The output will be increased from 90 hp. to 250 hp.

NOGALES, ARIZ.—The Southern Arizona Power Company has been organized to take over and merge the Nogales Electric Light & Power Company and the Arizona Gas & Power Company. Extensions will be made in power plants and transmission systems.

DILLON, MONT.—The Union Electric Company has contracted with the Beaverhead Transmission Company for power supply. A 66,000-volt transmission line will be erected.

ALAMOSA, COL.— Work will soon be started on improvements to the local plant of the Colorado Power Company. New equipment, including a 750-kw. turbo-generator, new condenser and automatic stokers, will be installed.

DENVER, COL.—The United States District Court has ordered Ernest Stenger, receiver of the Denver Tramway Company, to purchase machinery and equipment for the main power plant of the company, the cost not to exceed $215,000.

MANITOU, COL.—The installation of an ornamental lighting system is under consideration by the Board of Trustees.

Canada

COBALT, ONT.—Work will be started early in the spring by the Canadian Associated Goldfields on completing the development of its Windego Falls power scheme on the Blanche River, south of the Kirkfield field.

HAMILTON, ONT. — Surveys are being made by the Dominion & Power Transmission for a 5-mile, single-track electric railway from Hamilton to McKittrick Survey.

TORONTO, ONT.—The property committee has instructed Commissioner Chisholm to submit a report and estimate of cost of installing gooseneck standards mounted with nitrogen lamps on all main thoroughfares.

Electrical Patents

Announced by U. S. Patent Office

(Issued Jan. 30, 1923)

1,443,439. PROCESS AND APPARATUS FOR INTRODUCING ELECTRIC ENERGY INTO A SPACE OF ACTION; G. T. Southgate, Washington, D. C. App. filed March 8, 1922. Electric furnace in which material acts as electrode.

1,443,451. MEASURED-SERVICE TELEPHONE SYSTEM; A. Anderson, Chicago, Ill. App. filed Dec. 30, 1913. Automatically indicates elapse of talking time on automatic system.

1,443,469. RHEOSTAT; J. Guthrie, Elyria, and J. W. Simmons, Cleveland, Ohio. App. filed Aug. 4, 1922. Carbon-pile resistance for vacuum-tube filament control.

1,443,494. TELEPHONE AUTOMATIC TRUNKING APPARATUS; T. G. Martin, Chicago, Ill. App. filed Jan. 17, 1907. Automatic trunk-selecting switch.

1,443,499. BRUSH RIGGING; H. S. Pardee, Chicago, Ill. App. filed April 22, 1920. Single frame holds two sets of brushes 180 electrical degrees apart.

1,443,580. ELECTRIC FURNACE; G. M. Little, Pittsburgh, Pa. App. filed March 23, 1921. Maintaining temperature of 2,500 deg. C. in resistor furnace.

1,443,581. ELECTRIC RESISTANCE TUBULAR FURNACE; G. M. Little, Pittsburgh, Pa. App. filed March 23, 1921. Employed to give green resistance rods initial baking.

1,443,583. ELECTRICAL PROTECTIVE DEVICE; P. MacGahan, Pittsburgh, Pa. App. filed March 13, 1918. Overload-protection relay.

1,443,590. METHOD OF SUPPORTING RESISTOR MOUNTING PLATES; T. A. Reid, Pittsburgh, Pa. App. filed March 30, 1921. Electric resistance furnaces.

1,443,604. JACK SWITCH; E. E. Yaxley, Chicago, Ill. App. filed Oct. 16, 1922. Telephone cord jack.

1,443,613. DETECTIVE AND PROTECTIVE DEVICE FOR ELECTRIC CABLES; C. J. Beaver, Hale, A. F. W. Richards, Brooklands, and E. A. Claremont, High Legh, England. App. filed Oct. 30, 1919. Metal shielding between conductors provided at joints.

1,443,620. TELEPHONE TRANSMITTER; R. A. Engler, Evanston, Ill. App. filed June 23, 1919. Transmitter can be used in both wired and wireless telephony.

1,443,644. ROTARY ELECTRIC MACHINE; K. Nobuhara, Muko-Gun, Hyogo-Ken, Japan. App. filed April 13, 1918. Cooling liquid in both stator and rotor but forced out of clearance space by gas.

1,443,645. AUTOMATIC TELEPHONE SYSTEM; W. T. Powell, Rochester, N. Y. App. filed Feb. 18, 1920. Talking connection extended through trunking switch individual to each line.

1,443,646. AUTOMATIC TELEPHONE SYSTEM; W. T. Powell, Rochester, N. Y. App. filed March 8, 1920. Conversational circuit extends only through non-numerical switches.

1,443,657. INSULATOR; L. Steinberger, Brooklyn, N. Y. App. filed Nov. 23, 1917. Different electrostatic capacity of successive units whereby more uniform distribution of stress is secured.

1,443,669. ELECTRICAL CONNECTION; J. M. Andersen, Boston, Mass. App. filed April 4, 1921. Connection of apparatus to laminated busbars.

1,443,748. LIGHTING FIXTURE; W. R. Kahns and Karl Keller, Brooklyn, N. Y. App. filed March 28 1922. Portable lamp provided with shade that may be raised and adjustable sockets.

1,443,763. CIRCUIT MAKER AND BREAKER; G. L. Smith, Washington, D. C. App. filed May 10, 1920. Motor-vehicle signaling apparatus.

1,443,766. CONTROL SYSTEM FOR ELECTRIC ELEVATORS; W. S. Smith, Cambridge, Mass. App. filed Aug. 3, 1918. Dual-control system, one automatic, the other manual.

1,443,797. ELECTROLYTIC CELL; C. W. Marsh, Greenwich, Conn. App. filed Dec. 19, 1919. Construction of U and V type cells.

1,443,798. WELDER'S TONGS; R. Mattice, Philadelphia, Pa. App. filed July 7, 1921. Current cable fastened to handle end and passed down through center of tongs.

1,443,816. ELECTRIC FURNACE; F. A. Fitzgerald, Niagara Falls, N. Y. App. filed Jan. 13, 1921. Arc type heated by radiation from single-phase arc.

1,443,873. MULTIPLE-ROLLER ELECTRIC TRANSMISSION TROLLEY; G. Donham, Oakland, Cal. App. filed Dec. 20, 1921. Trolley collector made up of five wheels.

1,443,935. RESINOUS PRODUCT; L. Weisberg, Grantwood, N. J. App. filed Sept. 24, 1921. For molded insulating material.

1,443,936. PROCESS OF MAKING A MOLDING COMPOSITION; L. Weisberg, Grantwood, N. J. App. filed Sept. 24, 1921. Mixture of glycerol-polybasic acid resin and shellac.

(Issued Feb. 6, 1923)

1,443,984. REPEATER APPARATUS FOR CARRIER SYSTEMS; L. Espenschied, Hollis, N. Y. App. filed June 19, 1919. Special high-frequency repeater operates in parallel with low-frequency repeater of communication line.

1,443,985. SIGNALING SYSTEM; L. Espenschied, Hollis, N. Y. App. filed June 21, 1919. Simultaneous transmission and reception of radio signals by employing carrier waves of different frequency.

1,444,000. ELECTRIC SWITCH; H. J. Morey, Syracuse, N. Y. App. filed Oct. 4, 1918. Pull-chain lamp socket.

1,444,057. GRIP CONDUIT FOR ELECTRIC CONDUCTORS; M. W. Bosley, Baltimore, Md. App. filed Jan. 20, 1921. Wooden moldings for house wiring.

1,444,084. DISTRIBUTING BRUSH HOLDER FOR MAGNETOS WITH TWO SIMULTANEOUS SPARKS; P. J. R. Postel-Vinay, Paris, France. App. filed March 6, 1921.

1,444,113. PROCESS FOR PLATING ON NON-METALLIC SURFACES; E. F. Dietrich, Chicago, Ill. App. filed May 20, 1922. Metals permanently deposited on non-metallic surfaces by electroplating bath.

1,444,211. TIME RECORDER; T. Ross, Chicago, Ill. App. filed April 1, 1921. Driving and setting mechanisms of time recorders.

1,444,242. SPACING APPLIANCE; A. A. Faust, Detroit, Mich. App. filed Aug. 11, 1921. Control of metal-working machines.

1,444,267. ELECTRIC LANTERN; A. A. Pearson, Portland, Ore. App. filed Oct. 12, 1921. Adapted to railroad-yard work.

1,444,286. MEANS FOR CONTROLLING AND REGULATING ELECTRIC CURRENTS; T. L. Vaughn, Jr., Dunn, N. C. App. filed Nov. 30, 1921. Constant-voltage regulator for a group of lights.

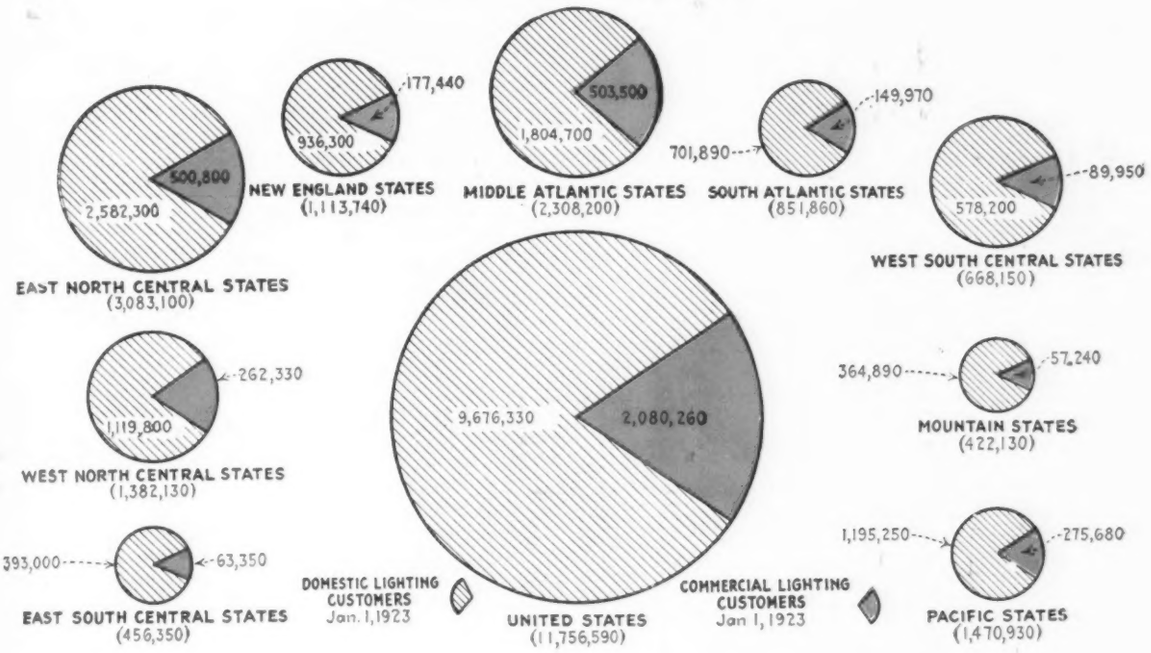
1,444,363. BRUSH-HOLDER RETAINER; R. N. Baylis, Bloomfield, N. J. App. filed June 7, 1922. Pressed metal holder.

1,444,417. MULTIPLEX SYSTEM IN TELEDYNAMIC CONTROL; J. H. Hammond, Jr., Gloucester, Mass. App. filed Oct. 17, 1917. System for controlling several devices selectively from distance in response to radiant energy

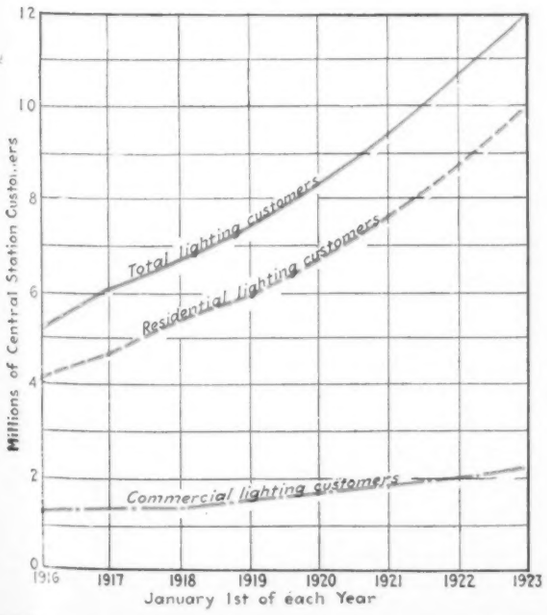
Business Facts for Electrical Men

Selected Statistics Presented Graphically for the Use of All Interested in Analyzing the Trend of the Electrical Business

Distribution of Central-Station Lighting Customers on Jan. 1, 1923—Comparison of Domestic and Commercial Lighting Customers by Sections



Rate of Growth in Number of Lighting Customers Has Increased Year by Year

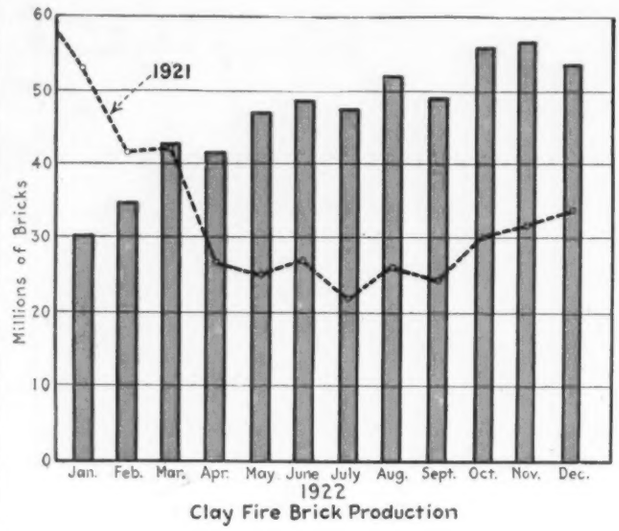


The Significance of Growth

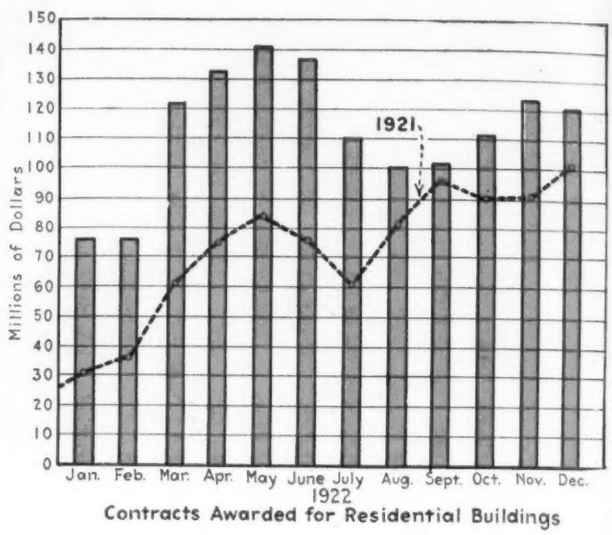
INDUSTRY grows in two ways. There is mushroom growth — an industry springs up over night as a result of some great and immediate economic need and sinks to comparatively small operations or into total oblivion after the emergency has passed. The world war brought many instances of this type of growth.

Then there is the development that is a cautious but steady advance — industry builded upon a carefully laid foundation and gradually intertwining itself into the very economic fabric of the country. Industry so buttressed will endure as long as the nation itself. And of such is the electric light and power industry. In age a mere infant among other primary industries, it has taken its place in the front rank of great enterprises and challenges all others in the service it is rendering to humanity.

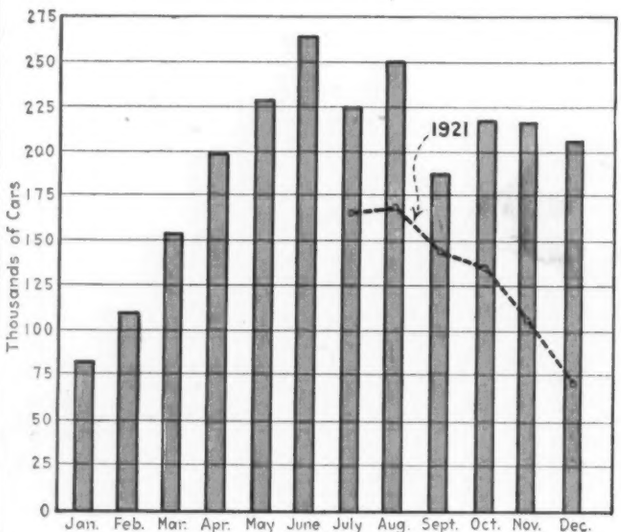
How the Primary Industries Are Trending



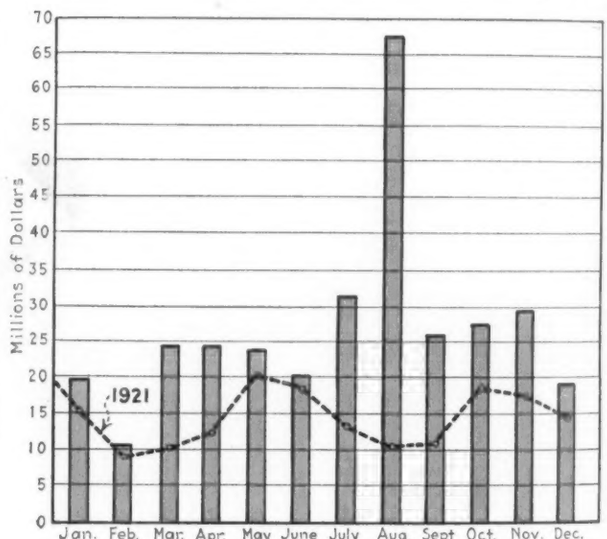
Clay Fire Brick Production



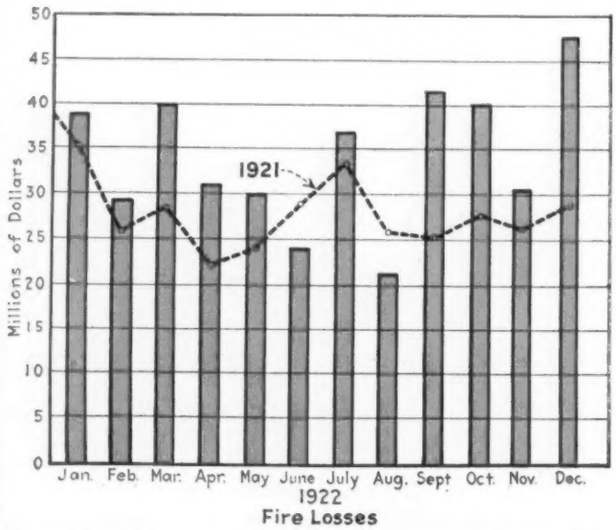
Contracts Awarded for Residential Buildings



Passenger Automobile Production



Contracts Awarded for Industrial Buildings



Fire Losses

They All Agree

A STUDY of the prognostications of various statistical and economic bureaus on business conditions for 1923 bring out most vividly the optimism which is so prevalent in the business world today. All these students of economic trends agree that as a result of "the soundness of basic conditions and the strength of the favorable economic forces" business will continue to grow in volume at least during the first half of the year. The Harvard University Committee on Economic Research sums up the situation by the prediction of "further increase of wholesale commodity prices and continued expansion of business activity during the first half of 1923, with a strong probability that the upward swing will continue during the second half of the year."